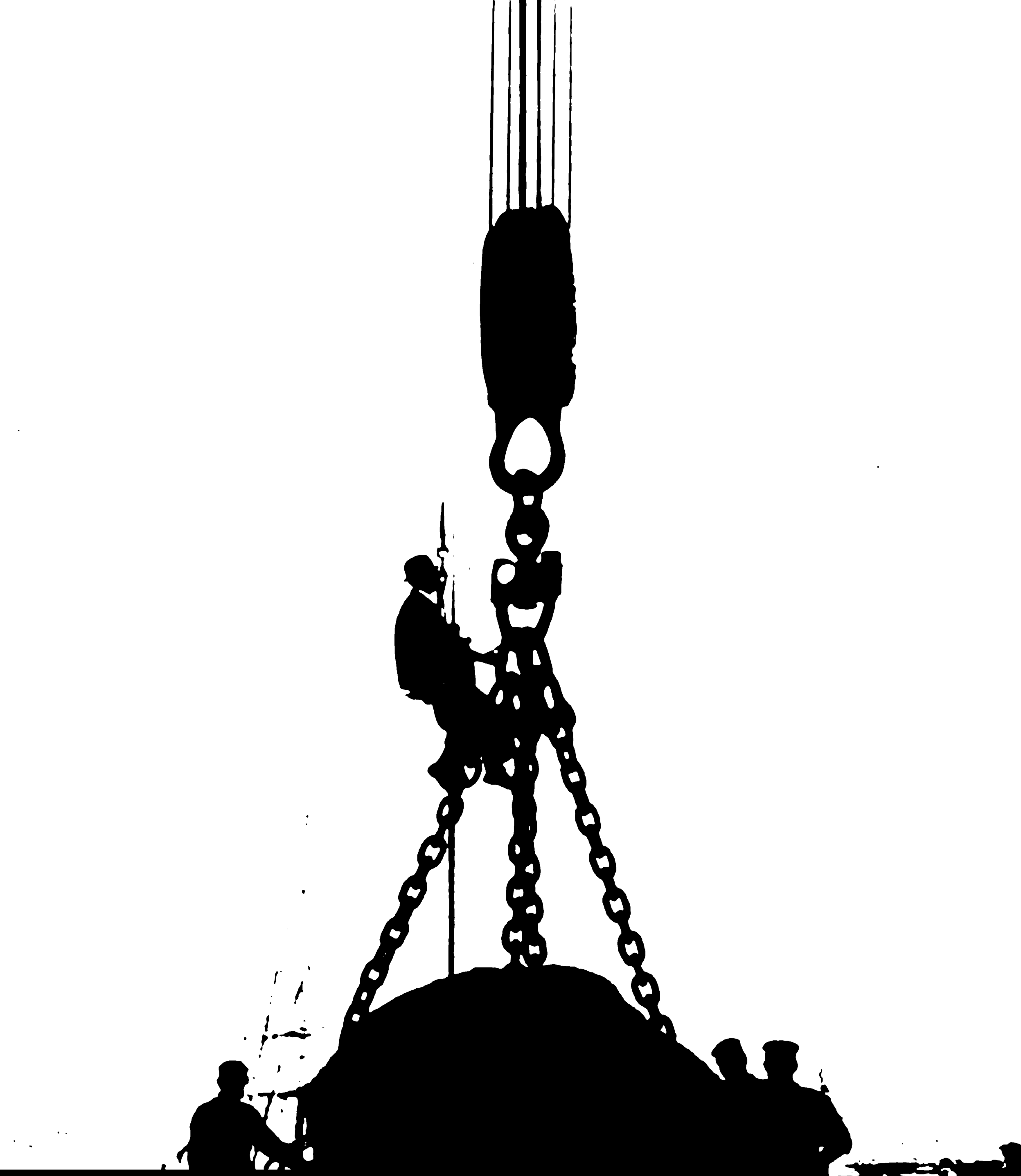

The American Museum Journal

American Museum of Natural History

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The American Museum of Natural History

77TH STREET AND CENTRAL PARK WEST, NEW YORK

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The largest of the Cape York meteorites. Removal from the Cob Dock, Brooklyn Navy Yard

The American Museum Journal

VOL. V. JANUARY, 1905. No. 1

THE CAPE YORK METEORITES.

SINCE the time of Captain Ross's voyage to northern Greenland in 1818, the world has known that the Eskimo whom he found there were provided with knives and other utensils which were armed with iron. The source of this iron was a puzzle, since the Eskimo did not then possess, nor do they now have, the means for reducing any of the metals from their ores. The natives merely said that the metal came from the "Iron Mountain," and they would give neither Ross, nor any of the succeeding explorers who have visited the region, exact information regarding its location, until Commander Robert E. Peary gained the esteem and confidence of the tribe to such an extent that the secret was revealed to him. On May 27, 1894, he and Hugh J. Lee, a member of his expedition, under the guidance of Tallakoteah, an Eskimo, were the first white men to behold any of the "Saviksue" or Great Irons. Two hundred miles of terrible sledge travel, amid many and great dangers, had been necessary to attain this object.[1] On this trip was found the medium-sized mass known as the Woman, now on the fourth floor of the Museum, but the advent of stormy weather and the rapid approach of the breaking-up of the ice in the spring prevented visiting the largest mass, which was only six miles away on another small island. Tallakoteah picked up a boulder lying beside the Woman and illustrated the method used by his ancestors for getting material for their knives by pounding at an edge of the mass until a bit of the iron was loosened enough to be removed. Not since about the time of Ross's visit have the Eskimo resorted to

[1] A thrilling account of this journey and a full description of the removal of the Saviksue to New York may be found in Commander Peary's book, "Northward over the Great Ice."

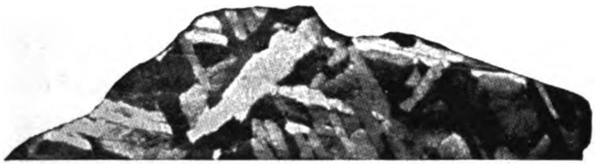
the Saviksue for iron, their wants being met by whalers and by trading with the natives farther south.

In 1895, Peary returned to Melville Bay and took his ship to Saviksoah Island to obtain the masses of iron. The Woman and a smaller meteorite, known as the Dog, from its size and shape, were successfully loaded on board the ship "Kite" after much difficult and exciting work, an incident of which was the breaking-up of the cake of ice on which the Woman had been ferried from shore to ship, just as the mass was about to be hoisted aboard. Fortunately, there was enough tackle around the iron to prevent the loss of the object which had been so long and eagerly sought. Without further incident, the two masses of iron were transported to New York and deposited at the Museum. The great mass, called by the Eskimo "Ahnighito" or the Tent, was visited by Commander Peary on this trip, but with the means at hand nothing could be accomplished toward moving the iron from the ledge on which it had rested for ages.

The following year, the indefatigable explorer made another voyage to the inhospitable shores of Melville Bay to bring Ahnighito away. Again was the project unsuccessful, by reason of inadequate apparatus and inclement weather. Once more, in 1897, Peary returned to the attack, this time with a one-hundred-ton and two thirty-ton jacks and ample supplies of railroad iron and great timbers, determined to win at all hazards. To transport a compact, rounded mass of iron of great weight down a rocky slope several hundred yards to the sea and to store it safely, with no dock or dock machinery, in the hold of a ship for a journey of three thousand miles would be difficult under any circumstances, but the problem of moving Ahnighito was vastly complicated by the ice, the fog, the winds and the other adverse conditions of the west coast of Greenland at latitude 76° N., and the task may well be compared with that which faced Lieutenant Gorringe in removing the obelisk from Egypt to Central Park. The ship "Hope," built expressly for Arctic exploration, was moored directly to a rocky promontory, where she lay at the mercy of any storm that might come up, while the last days of the anxious work were progressing. As the monster meteorite came aboard ship, the four-year-old daughter of Commander

Peary, herself born near Cape York, broke a bottle of wine over the mass and christened it "Ahnighito," her own musical name.

With the great mass secured within the hatchcombings, the prow of the "Hope" was turned away from Saviksoah Bay and full steam was crowded on to escape from the dangerous place, where the rapid forming of new ice, presaging winter, threatened the adventurous white men with long imprisonment. Great anxiety was felt by the intrepid Peary and his men while the ship was forcing her way out of Melville Bay, for it was several days before the great mass of iron could be lowered to the bed of stone ballast provided for it deep in the hold and be secured where it could not overturn the vessel or break through her sides during a storm.



ETCHED SURFACE OF AHNIGHITO, SHOWING WIDMANSTÄTTEN LINES

From the autumn of 1897, when the "Hope" discharged her valuable load at the Cob Dock of the Brooklyn Navy Yard, Ahnighito lay there in comparative obscurity until last September when the great mass was once more set in motion. Lifted by a great crane which makes child's play of handling a mogul locomotive, the meteorite was transferred to a lighter and towed around to the foot of Fiftieth Street, North River, where a massive iron truck, capable of carrying a 100-ton load, was in waiting for the last stage of the journey. Twenty-eight powerful horses, forming a line the length of an avenue block, were required to pull the truck and its load through the streets. On October 1, the great meteorite arrived at the Museum and ended its travels. Here it rests on a six-foot cube of solid concrete and rubble. The dimensions of the iron are, length 10 feet 10 inches, height 7 feet 2 inches, thickness 5 feet 6 inches.

In order to determine the exact nature of these great masses of iron, chemical analyses of all three have been made and slices

have been cut from the Woman and Ahnighito, which have been carefully polished and etched in order to determine the presence and character of the Widmanstätten lines. The analyses [1] show that the material is an alloy of iron and nickel, with a small amount of cobalt and minute percentages of other elements present. The etched surface shows that the iron is to be described as belonging in the octahedral division. The lamellæ are rather broad (1. to 1.5 mm) and under Brezina's classification the iron would be called a "Broad Octahedrite (Og)." The character of the figures may be seen from the accompanying illustration. (See p. 5.) The lamellæ are rather long and straight and sometimes gather together in groups.

The nature of the surroundings amid which the masses were found precludes the ideà of their being anything but meteorites. The country rock is gneissoid in character, according to Professor R. D. Salisbury, who visited the island in 1895 with Commander Peary, and neither in the bedrock nor in the glacial drift covering the region, so far as seen, is there any of the igneous rock which is the only telluric rock known to contain metallic iron. The position of the meteorites when found, half-buried in drift, seems to indicate that they fell on the ice at a time when a glacier covered the islands. The close similarity of the three in position, chemical composition and texture renders it most highly probable that they fell at the same time. The Eskimo preserve a tradition, the origin of which is lost in antiquity, that the

[1] Results of chemical analyses of the Cape York meteorites made by J. Edward Whitfield of Philadelphia:

	No. 1. The Dog.	No. 2. The Woman.	No. 3. Ahnighito, or the Tent.
Iron	90.993 %	91.468 %	91.476 %
Nickel	8.265 "	7.775 "	7.785 "
Cobalt	0.533 "	0.533 "	0.533 "
Copper	0.016 "	0.018 "	0.014 "
Sulphur	0.019 "	none	none.
Phosphorus	0.172 "	0.188 "	0.202 "
Carbon	0.014 "	0.020 "	0.028 "
	100.012 %	100.002 %	100.038 %

None of the samples contained silicon or manganese. A trace of chromium was found in the fine oxidized particles from the surface of No. 3, Ahnighito, indicating the former presence of a nodule of variable composition.

Saviksue fell to the ground from the sky. Taken together they form the most interesting group of meteorites in any museum, not only on account of the unusual size of the largest mass, which is probably the heaviest meteorite known, but also on account of the struggle for existence maintained with their aid for untold generations by the most northern group of human beings on the globe.

EDMUND OTIS HOVEY.

THE CHINESE HALL.

ON Saturday, December 3, Hall No. 301, in the West Gallery, containing extensive collections from China, was opened to the public. These collections are the results of an expedition to China the funds for which were generously furnished by Mr. Jacob H. Schiff of this city, Dr. Berthold Laufer being intrusted with the work. The collections are intended to show the entire culture of China of the present day and to illustrate the products of the country and the general every-day life of the people,—their customs and industries, their amusements and pastimes and their religion and art.

Opposite the entrance, just in front of the railing, are exhibited four ancient bronze drums and an altar set of stone carvings, the central piece of which represents an incense-burner. On either side of the incense burner is a large flower-vase in openwork carving and a candle-stick. In front of this set are five dishes containing various kinds of fruit all in stone.

In the wall-case to the right of the entrance is shown modern crockery made in Peking, in its simple burnt state and in glazes of green and brown and various other colors. In the wall-case on the other side of the entrance is to be found glazed pottery from Poshan in the Province of Shantung, and a large variety of gray flower-pots made in Peking. These are of various forms, and are tastfully decorated. Other cases just in front of these wall-cases contain specimens showing the process of manufacture of pottery in its various stages, and there is a fine display of

porcelain illustrating the different types and colors employed in that branch of art. There are teapots in terra-cotta, polychromatic flower-vases from Canton and a group of clay lamps. The various metal industries of China are represented by objects of bronze, tin, pewter, copper, silver and iron.

Along the north wall are represented implements of copper and iron, glassware, agriculture, basketry and matting. Household articles, kitchen utensils, clothing, foot and head gear, fans, weapons and armor are fully represented. In one section the blacksmith's trade is illustrated, and in an adjoining section the carpenter's.

An entire section is given up to an elaborate display of all kinds of tobacco-pipes, the dry pipes as well as water-pipes, and opium-pipes. The various brands of tobaccos, snuffs and other smoking-materials also find place here. In one case are drugs and the apothecary's outfit, surgical instruments and needles used in acupuncture, the horse doctor's outfit and implements used in massage treatment. Other cases display carpets, bamboo, coir palm, chemical products, medicines, hygiene and cosmetics.

On the west side in one case are exhibited articles of food, and the implements of various industries,—butcher's, baker's, fruit-seller's, cake-seller's, stone-cutter's etc. In a wall-case are lanterns of paper, pongee and horn and an altar set of papier-maché. An exhibit of dolls showing various styles of dress is also to be seen on this side of the hall. In the same case is exhibited quite a collection of pigeon whistles. These whistles are attached to the tails of pigeons by means of fine wires, and when the birds fly through the air a plaintive sound is produced by the wind striking the holes in the whistles. Besides these, money, weights and measures; harness; shows, games and toys, and actors' paraphernalia and masks are all represented.

A special flat case in the southwest corner contains objects fully illustrating the printer's art; and along the south side of the hall are exhibited religion; wood, ivory, and stone carving; cloisonné and carved lacquer work; ancient pottery; musical instruments; embroidery, decorative art, drawing and painting, and ancient bronzes.

DEPARTMENT OF VERTEBRATE PALÆONTOLOGY.

THE field work carried on by the Department of Vertebrate Plæontology in the Bridger Badlands in 1903 was continued during the season of 1904 by another expedition under the charge of Mr. Walter Granger. Parts of the region not visited or but slightly worked the previous year were carefully explored and much valuable and important material was obtained.

The Bridger beds are a Middle Eocene deposit in the southwestern part of Wyoming and lie for the most part between the Union Pacific railroad and the Utah State line. They cover an area of about two thousand square miles and represent a total thickness of nearly two thousand feet. In many places throughout this area, especially along the streams, these beds are cut and weathered into rough, rugged and very picturesque badland bluffs and slopes which have yielded to collections a large variety of very interesting fossil mammals as well as remains of turtles, crocodiles, lizards, fishes and birds. The first mammals to be reported from these beds were described about 1870 by Dr. Leidy from specimens secured by the Hayden Survey and by people residing at Fort Bridger. Since that time the country has been searched over by various parties, notably those sent out by Yale and Princeton Universities, the American Museum and by Professors Cope and Leidy

The expedition from this Museum in 1893 which visited this locality and also the Washakie Beds, a nearly contemporaneous deposit lying some seventy-five miles to the westward, was fortunate in securing numerous skulls and some skeletal parts of *Uintatherium*, a large rhinoceros-like animal with three pairs of horns and a very large, flat, curved tusk or canine. This was by far the largest and most striking of the animals of this period. There was not sufficient material with which to compose a skeleton, however, and one of the chief objects of the expeditions of 1903 and 1904 was to secure the material necessary for a complete restoration of this beast, or better still a complete skeleton of one individual. The first season the party was working most of the time outside of the rather restricted area of the basin in which the uintatheres are found, but this year two important

specimens, fortunately of nearly equal size, were found, and a restoration of *Uintatherium* now seems assured. One of these skeletons was found in a very interesting and unusual position. The animal had evidently been mired in the clay in which the bones were found imbedded, and had died while the body was in an upright position. When excavated, the limbs were found extending straight down in a nearly natural pose, the hip was in place, but the skull, neck and most of the back had been weathered away.

Among the other specimens obtained during the past season were remains of rodents, carnivores, insectivores, monkeys and the primitive Horse *Orohippus*. The collections of the past two seasons are especially rich in specimens of these smaller forms and supplement admirably the material obtained from the same beds by the earlier expeditions.

Mr. Albert Thomson spent about four months collecting in the Big Badlands of South Dakota. This is the fourth expedition sent by the Museum to the famous Oligocene deposit. The locality has probably been more productive of fossil mammal remains than any other equal area in the world, and notwithstanding the numerous collections made there, the area appears not to have been exhausted. The expedition of 1904 secured a collection comprising nearly one hundred specimens and included at least two new genera and several new species. The new genera are a small ruminant and a rodent, intermediate in skull structure between the beaver and the squirrels. The collection also included two fine skulls of the large Perissodactyl, *Titanotherium*, and several fine skulls and jaws of the smaller rhinoceroses, as well as two turtles new to science, one a dermatemyd, the other a species of *Testudo*.

Mr. Barnum Brown conducted four expeditions during the summer of 1904. The first explored the Fort Pierre beds of South Dakota near Edgemont, where a unique collection of plesiosaur remains were obtained which will enable the Museum to place on exhibition the restored skeleton of this interesting sea serpent. There are two skulls with jaws in this collection and one specimen includes the skull, jaws and about 15 feet of neck, one paddle and part of body.

The second expedition, in Montana, obtained considerable material from the Judith River beds, including the greater part of a *Trachodon* skeleton. From the Fort Benton formation on the Crow Indian Reservation, several new forms of crocodiles were obtained.

The third expedition, in New Mexico, explored a hitherto unnoted deposit of Laramie Cretaceous, finding a large Diclonius skull and jaws. The most notable find, however, was made in the fourth expedition in the Pleistocene Crevasse of Northern Arkansas from which were secured several thousand skulls, jaws and limb bones representing about fifty species, many of which are living, while not a few are extinct forms. The collection is now being worked up and will prove of great interest in showing the range and distribution of many forms.

MUSEUM NOTES.

THERE is an increasing demand from teachers for the circulating collections which the Museum loans to public schools. More than a hundred of the schools of the city are using them at the present time. They have been studied by more than 30,000 children since the schools opened in September. The sets of birds and insects are most popular. This plan of supplying small nature study collections to the elementary schools has attracted considerable attention outside the city. Professor A. C. Haddon of the Horniman Museum, London, who, during a recent visit to the Museum, showed great interest in our work and made a careful study of our methods of supplying this material, has written for circulars, labels and other literature relating to this work, in order that he may present the project to the London County Council and persuade it to provide similar collections for the public schools of London.

THE International Congress of Arts and Sciences, at the Louisiana Purchase Exposition in September, 1904, brought to this country an unusual number of eminent scientific men, many of whom stopped at the Museum on their way to or from St. Louis.

Among the delegates to the Congress who have visited the Museum since September may be mentioned Sir William Ramsay, Sir John Murray, Dr. H. R. Mill, Major A. St. H. Gibbons and Professor Oldham of England and Scotland; Professors Cordier, Grandidier and Thoulet of France; the Graf von Pfeil and Professors Hugo Erdmann and Verworn of Germany; Professors Albrecht Penck and Eugen Oberhummer of Austria; Dr. Bela Erödi of Hungary; M. de Claparède of Switzerland; Professor Sraute Arrhenius of Sweden; Commissioner Maldanago of Chili; Dr. Garland of Peru; Colonel Peña of Mexico; Dr. Arpiazu of Spain, and Professor Kakichi Mitsukuri of Tokyo.

On the evening of September 13, there was given a joint lecture by Dr. William Hunter Workman and Mrs. Fanny Bullock Workman on "Explorations among the Himalayas," under the auspices of the American Geographical Society and the Museum. The lecture was complimentary to the International Geographic Congress then in session.

October 3 Professor Hugo de Vries, the eminent Dutch botanist, was the guest of the Museum.

The most important accession to the Library during the year has been the gift of the private scientific library of Professor H. C. Bumpus, amounting to more than three hundred volumes and twenty-seven hundred pamphlets. This collection is especially rich in works in comparative anatomy and brings to the Library many valuable works and rare reprints not heretofore owned by the Museum.

The Department of Geology has recently received a remarkable series of fossils from the beds of Hudson River age near Cincinnati, Ohio. All the specimens are in beautiful condition and many rare forms, especially of Echinoderms, are represented by several specimens.

On December 2, the New York Academy of Sciences held a special meeting at the Museum for the purpose of hearing a lecture by Professor Albrecht Penck of the Imperial University of

Vienna. Professor Penck, who is an Honorary Member of the Academy, chose for his topic "The Glacial Surface Features of the Alps," a subject in which he is an eminent authority on account of the twenty years of almost continuous study that he has given to the valleys of these mountains.

DECEMBER 5, Prince Fushimi of Japan and his staff visited the Museum, spending most of their time in the recently opened Chinese Hall. A reception was tendered the prince by President Jesup and the Trustees of the Museum.

AFTER Mr. Chapman's lecture on "The Home Life of Flamingos," December 8, the Members of the Museum and their friends had a preliminary view of the Flamingo group and the San Joaquin Valley group which are in course of preparation at the north end of the Hall of North American Birds. These groups are the most elaborate bird groups thus far attempted at the Museum. Like the Cobb's Island group, a large part of the effectiveness of the scene depends upon the painted background which is introduced. The San Joaquin Valley group represents the broad, flat river valley with the Coast Range Mts. in the distance and illustrates the effects of irrigation in an arid country, not only upon the agriculture, but also upon the birds which the ample supply of food has induced to take up their residence in a region otherwise hostile to them. The Flamingo group represents a scene on an uninhabited island in the Bahamas, and has been developed from photographs, birds and accessories which were obtained there by Mr. F. M. Chapman, Associate Curator of Ornithology, last May and June, upon an expedition a summary account of which was given in the October, 1904, number of the JOURNAL. Mr. Chapman is the first naturalist to behold the flamingos in their home and to observe their nesting habits.

THERE has been installed in the new foyer, a representation of a part of the solar system, which is attracting considerable attention from visitors on account of its unique and instructive character. The sun is represented by an illuminated globe, six inches in diameter, and several of the planets are shown by means of lights of the proper comparative size placed at distances from

the globe representing the sun which correspond to the radii of their orbits. With a sun of the diameter chosen, it is possible to get only Mercury, Venus and the Earth into the foyer, which is 112 feet across. Mars is in the West Corridor and Jupiter is at the extreme end of the Wood Hall, 233 feet distant. The orbits of Saturn, Uranus and Neptune are so great that they cannot be gotten into the building on the scale selected for the sun. The light for Saturn would have to be placed out in the avenue, while that for Uranus would be twice as far away and that for Neptune would be more than a quarter of a mile from the sun's globe in the foyer, or nearly half-way across Central Park.

Acting upon the request made by the New York City Teachers' Association, the Museum arranged a series of informal lectures for school children, which have been given by members of the scientific staff of the Museum on Monday, Wednesday and Friday afternoons during October, November and December. The subjects were selected by the Committee on Children's Interests of the Association, with the purpose of supplementing the regular class-room work. There were twelve lectures in all, each of which was given three times, covering topics in geography, history, astronomy and physiology, and they were given according to the schedule to be found on a succeeding page. At first it was believed that one of our small assembly rooms would be sufficient to accommodate the classes, but this proved entirely inadequate, and the lectures were adjourned to the large auditorium. The lectures have proved so popular that the auditorium has been filled to overflowing, and, in order to accommodate all the pupils who wished to attend the course, the Museum has given extra lectures on some of the topics. The children attend in classes, accompanied by their teachers. From twenty to thirty schools have been represented at each lecture, with from ten to two hundred pupils present from each. Classes have attended from schools from upper Manhattan and the Bronx, the lower East Side, Long Island City, Brooklyn and Staten Island. From October 1 to December 1, more than 20,000 children attended the lectures. The teachers have been warm

in their praise of this effort of the Museum to assist them, and many requests have been received that the course be continued in the spring. One teacher writes: "It is a great event for the little 'East Side' children to be taken to these lectures, and they always make special preparation days ahead. They heard the lecture on the American Indians October 28, and they have not ceased to talk about it. Every child has written a composition on the lecture."

MESSRS. G. H. Goss and H. D. Dodge of Waterbury, Connecticut, have given the Museum a choice lot of about 250 specimens of beetles collected by themselves on Mt. Kinabalu, British North Borneo.

MR. J. RHINELANDER DILLON has presented a fine nest of a wild honey-bee (*Apis mellifera*) built on the branch of a wild cherry tree.

SOME excellent wasps' nests from Brazil have recently been placed on exhibition.

A COLLECTION of butterflies and moths from the province of Yakutsk, Siberia, has been added to the collection.

THE exhibition collection of galls produced by insects has been rearranged and labeled in conformity with Guide Leaflet No. 16 on "The Insect Galls of the Vicinity of New York City."

DURING the past year the study collection of the Department of Entomology has been undergoing a complete rearrangement. The various collections which have been kept separate heretofore are being united so as to form a uniform series.

AMONG the instructive models which have been added to the series on exhibition in the Synoptic Hall, 107, are those of several Polyzoa and a huge *Synapta*. Several sponges have been mounted and tinted with the color of the living specimens as observed on the reefs of the Bahamas.

THE Department of Entomology recently received through the generosity of Mr. Samuel V. Hoffman a collection of about 3600 specimens of moths, principally from North America. This valuable addition contains many species new to our collection, as well as many other rare and desirable species.

THROUGH the kindness of Mrs. Edwin J. Benson of New York City, the Museum has obtained a series of 180 photographs from excellent negatives made by her during a particularly interesting trip in South America.

THE fine weather of Thanksgiving Day brought an unusually large number of visitors to the Museum, the total attendance that day being 7127. Much interest was manifested in the special exhibit of game birds appropriate to the day which was temporarily installed in the Main Hall on the second floor, and the auditorium was crowded to listen to a lecture by Dr. E. O. Hovey on "Russia—The Land and the People."

THE free lecture to the people on Christmas, Monday, December 26, was on "A Christmas Trip to the Tropics," and was delivered by Mr. F. M. Chapman to an audience which crowded the auditorium.

LECTURES.

MEMBERS' COURSE.

Thursday evenings at 8:15 o'clock.

The following programme was offered for the first part of the season 1904–1905:

November 17, 1904.—Dr. EDMUND OTIS HOVEY, "Russia—The Land and the People."

December 1, 1904.—Dr. WILLIAM MORTON WHEELER, "Shore and Island Life of the Bahamas."

December 8, 1904.—Mr. FRANK M. CHAPMAN, "The Home-Life of Flamingos."

December 15, 1904.—Prof. BASHFORD DEAN, "The Japanese—Their Social Life and Characteristics."

January 5, 1905.—Mr. LOUIS P. GRATACAP, "Mines, Quarries and 'Steel Construction.'"

January 12, 1905.—Prof. ALBERT S. BICKMORE, "Western Holland—Middleburg to Helder."

January 19, 1905.—Prof. ALBERT S. BICKMORE, "Eastern Holland—Utrecht to Gröningen."

The second course for the season will begin in February.

TEACHERS' COURSE.

The following lectures were given on Saturday mornings at 10:30 o'clock.

October 22.—Mr. FRANK M. CHAPMAN, "The Birds of Autumn and their Habits."

October 29.—Mr. FRANK M. CHAPMAN, "The most Profitable Methods of Bird Study for Teachers, Pupils and Bird Lovers."

November 5.—Dr. EDMUND OTIS HOVEY, "The Building of a Continent."

November 12.—Dr. EDMUND OTIS HOVEY, "The Physical Features of North America and their Origin."

November 19.—Mr. LOUIS P. GRATACAP, "How the Parks, Highways and Buildings of our City may be Used as Material for Nature Study."

November 26.—Mr. LOUIS P. GRATACAP, "The Industries of the Sea."

A second Course for Teachers will be given during the winter.

PEOPLE'S COURSE.

The following lectures were delivered Tuesday and Saturday evenings at 8 o'clock, in co-operation with the Department of Education of the City of New York.

Tuesdays:

October 25.—Dr. WILLIAM E. GRIFFIS, "Life in Korea."

November 1.—Mr. L. G. LEARY, "Syria and Palestine."

November 8.—Dr. WILLIAM E. GRIFFIS, "Street and Outdoor Life in the Mikado's Empire."

November 15.—Mr. FREDERICK A. NORTH, "Siberia."

November 22.—Dr. THOMAS P. HUGHES, "India."

November 29.—Mr. D. W. C. SNYDER, "How the People Live in Congo Land."

December 6.—Mr. GERHARDT C. MARS, "Cairo."

December 13.—Mr. FREDERICK E. PARTINGTON, "Morocco and Southern Spain."

Saturdays:

October 29.—Mr. ERNEST INGERSOLL, "Home and Society in Animal Life."

November 5.—Dr. LIVINGSTON FARRAND, "Primitive Culture and Types of Primitive Man."

November 12.—Dr. LIVINGSTON FARRAND, "Primitive Family Life and Organization."

November 19.—Dr. LIVINGSTON FARRAND, "Industrial Life: Hunting and Fishing."

November 26.—Dr. LIVINGSTON FARRAND, "Industrial Life: Fire-making, Pottery, Weaving."

December 3.—Dr. LIVINGSTON FARRAND, "Primitive Art."

December 10.—Dr. LIVINGSTON FARRAND, "Primitive Religions and Ceremonials."

The Free Lectures to the People will be resumed in January, 1905, according to the following programme:

Tuesday evenings at 8 o'clock:

January 3.—Prof. WALTER S. PERRY, "India: Life, Religion and Art of the Hindus."

January 10.—Prof. WALTER S. PERRY, "India under the great Mohammedan Conquerors: The Taj Mahal."

January 17.—Prof. WALTER S. PERRY, "Spain of To-day, and the Alhambra, the Fairy Palace of Moorish Art."

January 24.—Prof. WALTER S. PERRY, "Ceylon, 'The Pearl of India'; and Chinese Cities."

January 31.—Prof. WALTER S. PERRY, "Japan: The Life and Customs of Her Remarkable People."

February 7.—Dr. JOHN B. DEVINS, "Korea and Manchuria: The Land of the Morning Calm and the Gibraltar of China."

February 14.—Mr. ARTHUR STANLEY RIGGS, "The Real Filipino."

February 21.—Mr. ROLAND S. DAWSON, "Hawaii."

February 28.—Mr. L. G. LEARY, "Around the Historic Mediterranean."

Saturday evenings at 8 o'clock.

A course of eight lectures on Electricity by Professor CHARLES L. HARRINGTON.

January 7.—"Magnetism."
" 14.—"Statical Electricity."
" 21.—"Statical Electricity."
" 28.—"Dynamical Electricity."
February 4.—"Dynamical Electricity."
" 11.—"Dynamical Electricity."
" 18.—"Wireless Telegraphy."
" 25.—"Rõntgen Rays: Becquerel Rays."

PUPILS' COURSE.

The lectures to the pupils of the public schools were given according to the following schedule. The lecturers were Messrs. L. P. GRATACAP, R. W. TOWER, E. O. HOVEY, H. I. SMITH and G. H. SHERWOOD of the scientific staff of the Museum.

	Oct.	Nov.	Dec.	
Mon.	3	31	28	A Little Journey in South America.
Wed.		2	30	Physical Geography from Pictures.
Fri.	7	4	2	Industries of the United States.
Mon.	10	7	5	New York City—Past and Present.
Wed.		9	7	Scenes in the Western Hemisphere.
Fri.	14	11	9	Methods of Transportation—Past and Present.
Mon.	17	14	12	The Planets.
Wed.	19	16	14	The Islands of the Sea.
Fri.	21	18	16	Our Wonderful Bodies.
Mon.	24	21	19	Distant Asia and Africa.
Wed.	26	23	21	A Trip through Europe.
Fri.	28	25		The American Indian.

MEETINGS OF SOCIETIES.

The meetings of the various societies that make the Museum their home will be continued throughout the quarter. Papers on technical and general scientific subjects are read before these societies. These papers are often of popular character and are always of considerable general interest. The public is invited to attend the meetings, and members of the Museum, on making request of the Director, will be provided with programmes of the meetings as they are published.

The New York Academy of Sciences will hold its meetings as follows, at 8:15 P.M.:

First Mondays.—Business meeting and Section of Astronomy, Physics and Chemistry.
Second Mondays.—Section of Biology.
Third Mondays.—Section of Geology and Mineralogy.
Fourth Mondays.—Section of Anthropology and Psychology

On Tuesday evenings on varying dates meetings will be held by the New York Linnæan Society, the New York Mineralogical Club and the New York Entomological Society.

 FIG. 1. RESTORATION OF MESONYX, A GIGANTIC CREODONT. UPPER EOCENE OF UTAH. BY CHARLES R. KNIGHT. AFTER OSBORN

FOSSIL CARNIVORES, MARSUPIALS AND SMALL MAMMALS

IN THE

AMERICAN MUSEUM OF NATURAL HISTORY.[1]

By W. D. Matthew, Ph.D.

Associate Curator of Vertebrate Palæontology.

I. CARNIVORA.

The Carnivora live principally on the flesh of other animals and have teeth and claws adapted to such food. Most of them, however, eke out their proper food, in times of scarcity, or for mere variety, with berries, nuts, bulbs and roots or even with grass, and some, at certain seasons, find little else available. Carnivores have large canine teeth adapted for cutting or for cutting and chewing, but never for grinding. All of them have claws, and they use their feet in a more varied way than do the Herbivora, for seizing and striking as well as for running and jumping. They walk either upon the entire sole of the foot (bears) or upon the under surface of the toes (dogs, cats etc.), never upon the tips of the toes as do the hoofed animals

There are three divisions:

A, CREODONTA, OR PRIMITIVE CARNIVORA. Extinct land Carnivora with various primitive characters. None now extant.

B, FISSIPEDIA, OR TRUE CARNIVORA. Toes separate; terrestrial or amphibious; preying on land animals. Modern beasts of prey.

C, PINNIPEDIA, OR MARINE CARNIVORA. Web-footed, marine, fish-eating. Seals and Walruses.

Fossil land Carnivora are more numerous and varied than modern kinds. More than 250 fossil species have been described from the United States alone, while but 94 living species are recognized in this country. The majority of the fossil species

[1] This article forms No. 17 of the Museum series of Guide Leaflets and may be obtained in separate form.

fall into one or another of the living families and are more or less directly ancestral to the modern beasts of prey. The remainder belong to several extinct branches, not ancestral to any of the modern families, and are combined in the rather heterogeneous group of Creodonta. Seals and Walruses have not been found fossil, except in the most recent deposits, and nothing is known of their evolution.

A. CREODONTA, OR PRIMITIVE CARNIVORA.

In all modern Carnivora one tooth in the upper and one in the lower jaw are enlarged and especially adapted to the cutting of flesh. Each consists mainly of a high strong crest, or ridge,

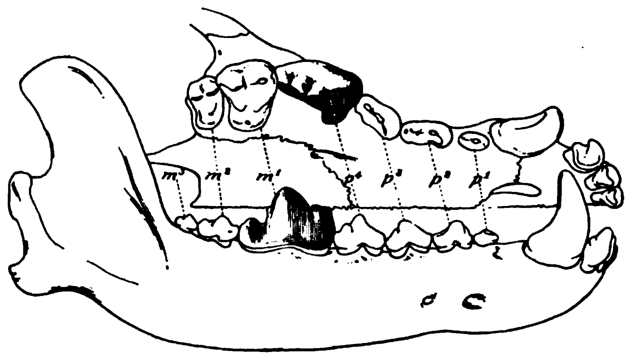


FIG. 2. UPPER AND LOWER TEETH OF THE WOLF
Shows the carnassials or flesh-cutting teeth (the fourth premolar in the upper jaw, the first true molar in the lower)

and the two crests, or "blades," work against each other like the blades of a pair of scissors. These teeth are called the "carnassials," or flesh-teeth. In all the modern Carnivora the fourth (last) upper premolar and the first lower true molar are the carnassial teeth. The fossil species show the gradual evolution of this specialized tooth in the various families of Carnivores. In the Creodonta, on the other hand, there is either no carnassial tooth, or it is developed from other teeth of the series,—in one group the first upper and second lower true molars, in another the second upper and third lower molars. (Compare Figures 2, 3, 4 and 5.)

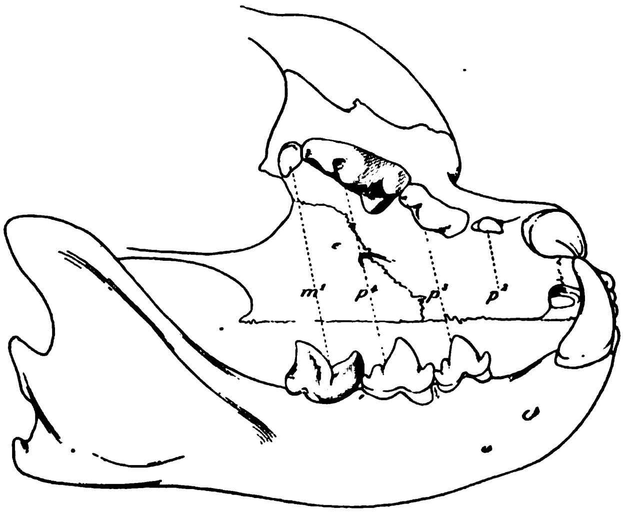


FIG. 3. UPPER AND LOWER TEETH OF THE LION
Shows the carnassials corresponding to those in the Wolf

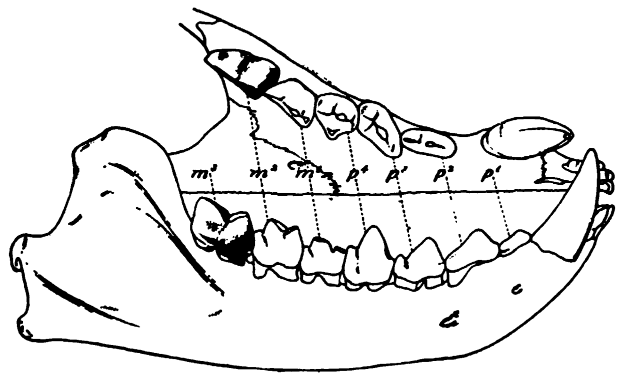


FIG. 4. UPPER AND LOWER TEETH OF HYÆNODON
Shows the carnassial teeth (second upper and third lower molar)

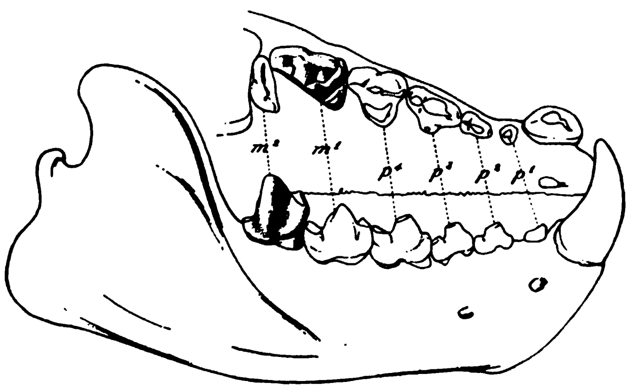


FIG. 5. UPPER AND LOWER TEETH OF OXYÆNA
Shows the carnassial teeth (first upper and second lower molar)

Another characteristic of all modern Carnivora is the union of two bones of the wrist, the scaphoid and lunar, which are distinct in most other animals. This gives additional strength to the thumb side of the very flexible wrist. In the Creodonts, these two bones were separate, and it is probable that they were separate in the earliest ancestors of the true Carnivores. Many

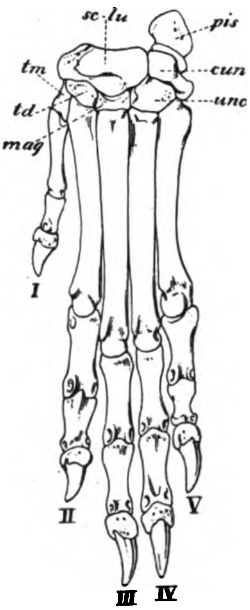


FIG. 6. FORE-FOOT OF THE WOLF
Shows the compact, slender foot, and the scaphoid and lunar bones of the wrist united (*sc-lu*) as in all true Carnivora

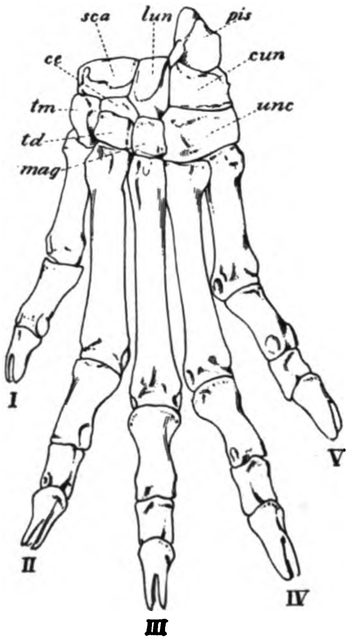


FIG. 7. FORE-FOOT OF HYÆNODON
Shows the shorter and less compact foot, and the separate scaphoid, centrale and lunar bones in the wrist (*sca*, *ce*, *lun*) as in all Creodonta

Creodonts also preserve a small extra bone, the "centrale," which is found now only in monkeys and in certain Insectivora and other small mammals. This bone seems to have been generally present in the ancient mammals.

The most ancient Creodonts are of especial interest to students, because they are thought to represent more nearly than any other fossils known, the central stock from which most modern mammals have descended. They appear already numerous

and varied, at the dawn of the Age of Mammals, and the different kinds become more and more specialized throughout the Eocene epoch. Meanwhile the true Carnivores appear in increasing numbers and gradually crowd out the Creodonts until the last of them has disappeared by the end of the Oligocene epoch. In their evolution the different Creodont groups specialized on much the same lines of development as those the true Carnivores took

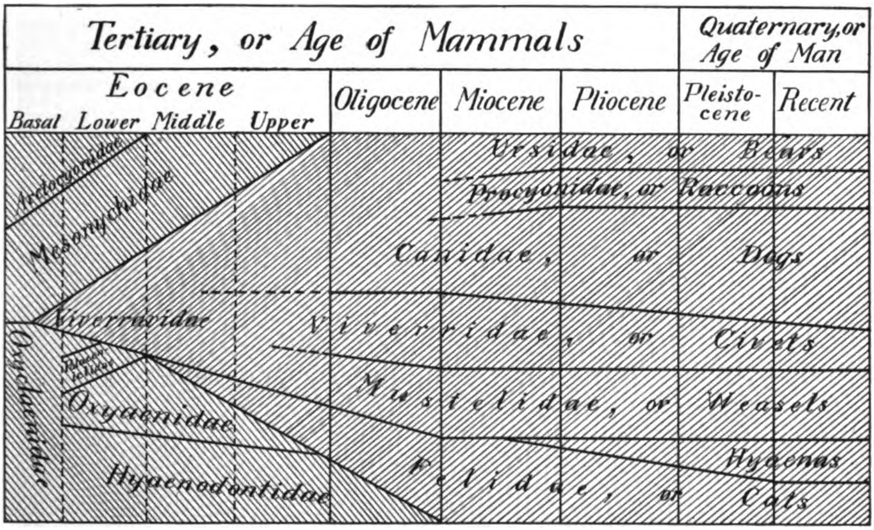


Diagram showing how the true Carnivora crowded out the Creodonta or Primitive Carnivora during the Tertiary Period.

Creodonta. True Carnivora.

FIG. 8

afterwards. They were more or less wolf-like, weasel-like, cat-like or bear-like, according to the nature of their food and the manner of attacking their prey.

Fossil remains of flesh-eating animals are by no means as common as those of Herbivora, and the remains of Creodonts are especially rare, and mostly fragmentary. The great majority have been found in the Eocene fossil fields of the Western United States. This Museum is peculiarly rich in these rare and interesting fossils. Out of the 113 American species it possesses all the known specimens of 50 and the types or other good

specimens of 48 others (including three complete mounted skeletons), while only 15 species are not represented.

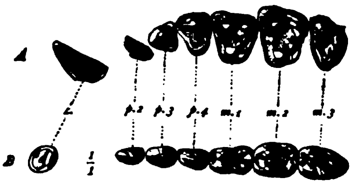


FIG. 9. UPPER AND LOWER TEETH OF TRICENTES
Represents the most primitive type of teeth of the Carnivora, with no specialized carnassials. Natural size

OXYCLÆNIDÆ.

Types: *Chriacus*, *Tricentes*, *Deltatherium*. Upper and lower jaws.

Small primitive animals with unspecialized teeth resembling those of lemurs. Only fragmentary specimens have been found, and but little is known about them. They are the most ancient group of the Creodonts and appear to have been nearest to the central stock from which the other Creodonts and Carnivores are descended. They are found only in the Basal Eocene.

ARCTOCYONIDÆ.

Types: *Arctocyon*, skull (cast); *Clænodon*, jaws and feet; *Anacodon*, jaws.

Bear-like omnivorous Creodonts with sharp canine teeth and the crowns of the molars flattened and wrinkled on the surface. The animal walked on the entire sole of the foot, and had large sharp claws like the modern bears. As in all these ancient mammals the brain was very small, as can be seen in the skull of *Arctocyon*.

PALÆONICTIDÆ.

Palæonictis, front of skull and jaws.

This rare and primitive group of Creodonts is thought by some authors to be the remote ancestor of the Cat family. It is found only in the Lower Eocene.

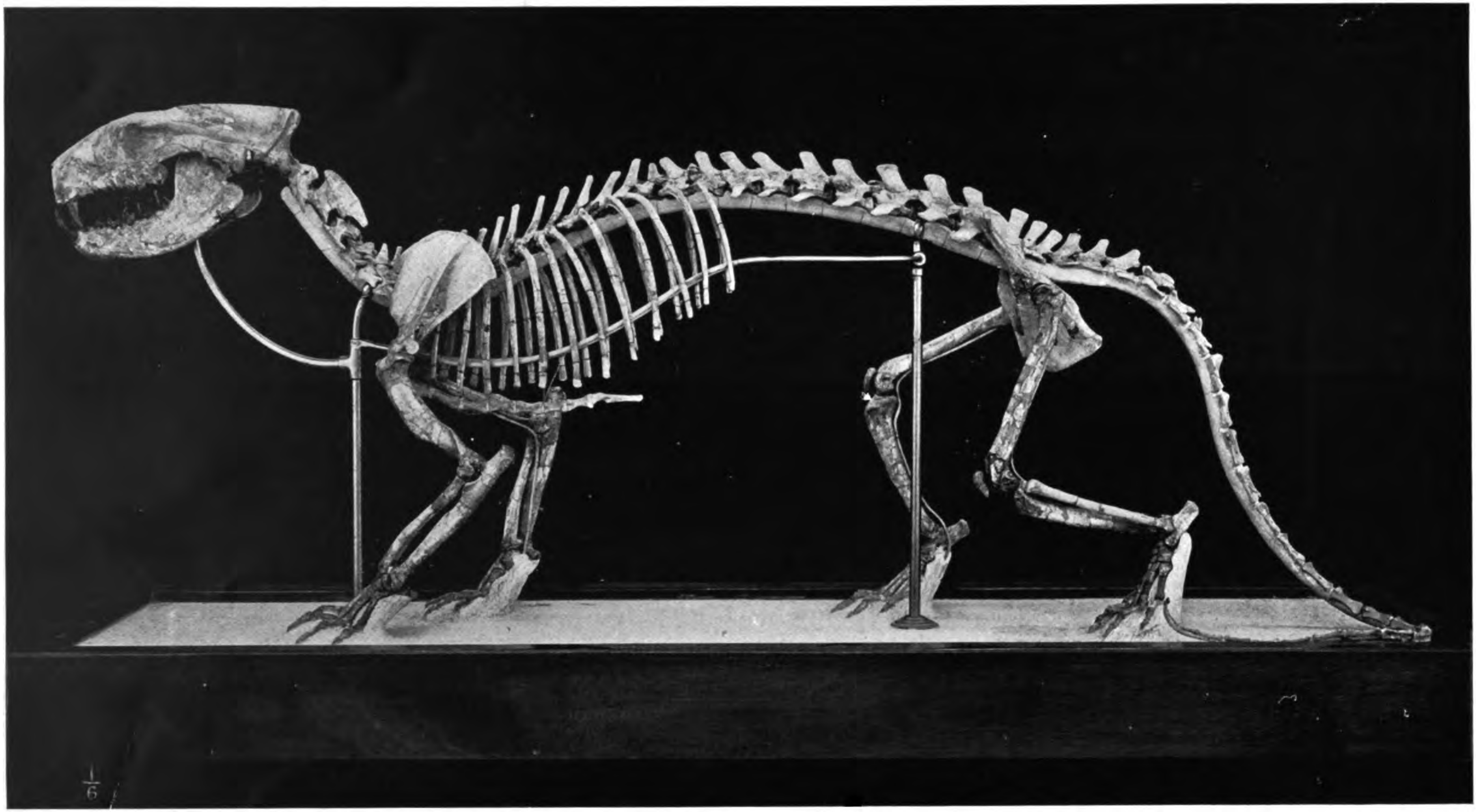


FIG. 10. MOUNTED SKELETON OF OXYÆNA LUPINA, AN ANCIENT TYPE OF CREODONT FROM THE LOWER EOCENE OF WYOMING
One-sixth natural size. After Wortman

OXYÆNIDÆ.

Types: *Oxyæna* and *Patriofelis*, skeletons.

Somewhat resembling the larger Mustelines, such as the Otter and the Wolverine, with short heavy jaws adapted to seize and hold their prey, with long body and with short powerful limbs adapted for leaping, climbing or swimming, but not for swift running. The tail was extraordinarily long, and was larger than in any of the modern Carnivora. The teeth were adapted for flesh-eating, the first upper and second lower molar being enlarged and specialized for cutting the flesh. (See Fig. 5.)

Oxyæna, from the Lower Eocene, was about as large as a Wolverine. The head is disproportionately large, and the tail as long as the entire body and head. The brain-case is very small, and the space for jaw-muscles very large, the whole organization much inferior to that of modern flesh-eaters. Powerful and savage it no doubt was, but far from having the keen intelligence, speed and endurance of the Carnivora of to-day.

The mounted skeleton of this rare animal is due to a fortunate accident. In the Cope Collection there was an incomplete and fragmentary skeleton collected in 1881 in Northern Wyoming by Dr. J. L. Wortman. In 1891 Dr. Wortman, while collecting for this Museum in the same region, discovered another fragmentary skeleton, also incomplete. After the purchase of the Cope Collection by the Museum, these two specimens were compared and found to be parts of the same individual, together constituting a nearly complete skeleton, which has been mounted and placed on exhibition, with the missing parts restored in tinted plaster.

In *Oxyæna* the last upper molar has disappeared, and the second possesses a large shearing blade placed transversely to that of the first molar. In *Patriofelis* of the Middle Eocene the second molar has become very small, and all the flesh-cutting is done by the first molar, shearing against the second lower molar. The teeth are therefore a stage farther advanced in specialization.

The *Patriofelis* skeleton is composed of two individuals of the same species which were found at the same horizon and locality. The animal was about as large as a jaguar, and massively pro-

portioned, with short heavy limbs and broad blunt-clawed feet. It has been thought that *Patriofelis* was of aquatic habits, and more or less nearly ancestral to the Seals; but it was more probably terrestrial, as its teeth indicate adaptation to flesh food, not to fish eating. The limbs and face most nearly resemble those of the short-legged Mustelines, otter, mink etc., among modern animals, and some of these are aquatic or semi-aquatic; but this resemblance may be merely because in both animals the limbs are short and heavy.

HYÆNODONTIDÆ.

Types: *Sinopa*, skull and other parts; *Hyænodon*, skeleton and skulls.

Two groups of animals are included in this family, one represented by *Sinopa*, small long-bodied weasel-like animals with teeth little specialized, suggesting those of the Opossum, the other by *Hyænodon*, which was larger, proportioned more like the Tasmanian Wolf, with teeth highly specialized for flesh-cutting. The first group was probably arboreal, the second terrestrial in habit.

In *Sinopa*, which was characteristic of the Eocene, the crowns of the molars are triangular and each has a longitudinal shearing edge in front and one transverse. In *Hyænodon* of the Oligocene the transverse shear has disappeared completely, the longitudinal shear is concentrated especially on the third lower and second upper molar, the third upper molar has disappeared, and the teeth are as highly specialized for flesh-cutting as those of the living Cats. (See Fig. 3.)

Hyænodon lived during the Oligocene epoch and was the last survivor of the Creodonts. In proportions it singularly resembles the Thylacine, or Tasmanian Wolf, of the rough bush-land of Tasmania. The head is of very large size, with long jaws and large teeth, adapted to snapping rather than seizing and holding on to the prey. The feet had large, rather blunt claws, not retractile, and the animal appears to have walked on the toes, like the dogs and cats, not resting the sole on the ground as do the bears. (See Fig. 6.) A finely preserved skeleton and several skulls from the Big Badlands of South Dakota are mounted in the collection. The largest skull is nearly a foot long.

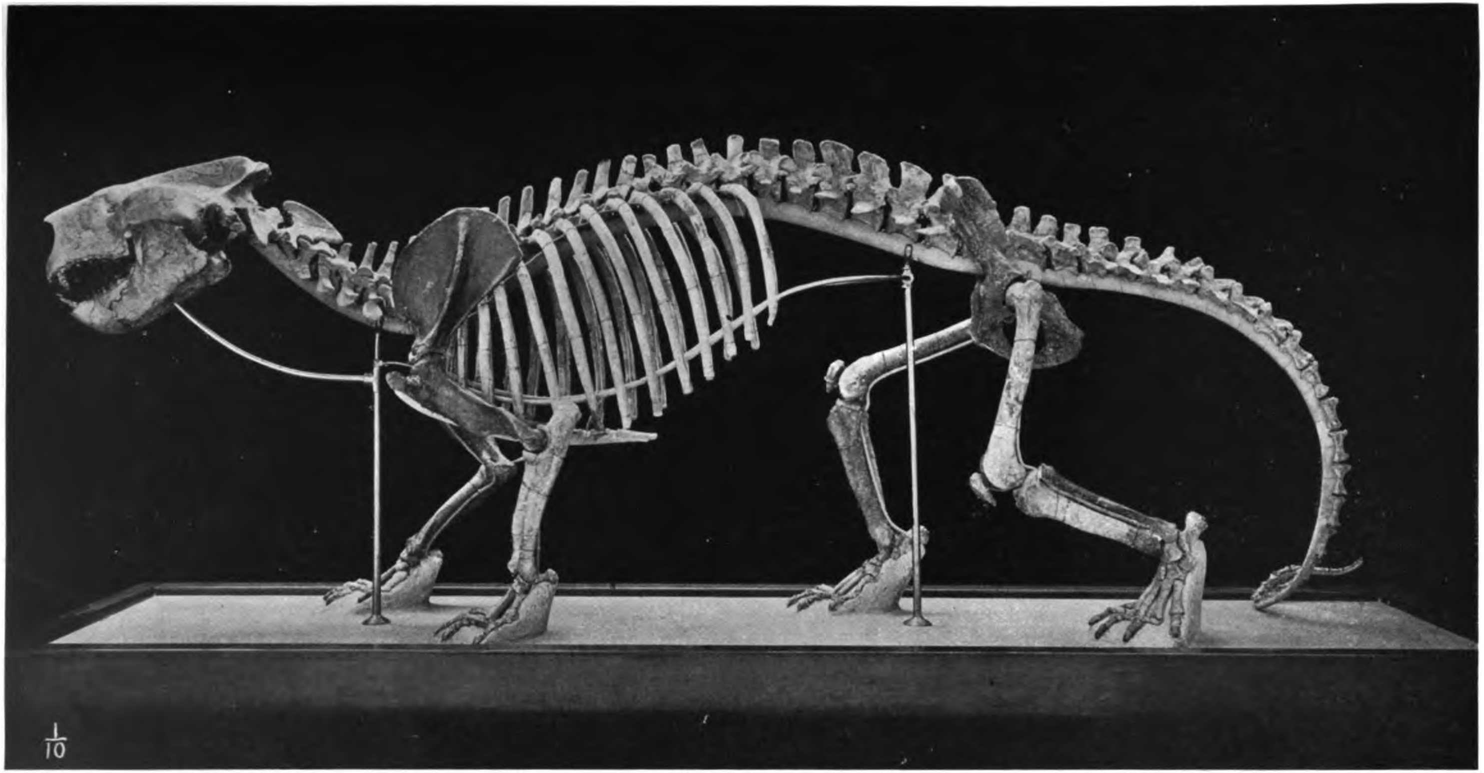


FIG. 11. MOUNTED SKELETON OF PATRIOFELIS FEROX, A CREODONT FROM THE MIDDLE EOCENE OF WYOMING
One-tenth natural size. After Osborn

MESONYCHIDÆ.

Type: *Mesonyx*, skull etc, Wall-case No. 6.

These animals had the limbs and feet specialized for swift running, and the feet tipped with flat hoof-like claws. The teeth are quite peculiar, they have no shearing edges, and the crown is composed of three rather high blunt-topped conical cusps. In

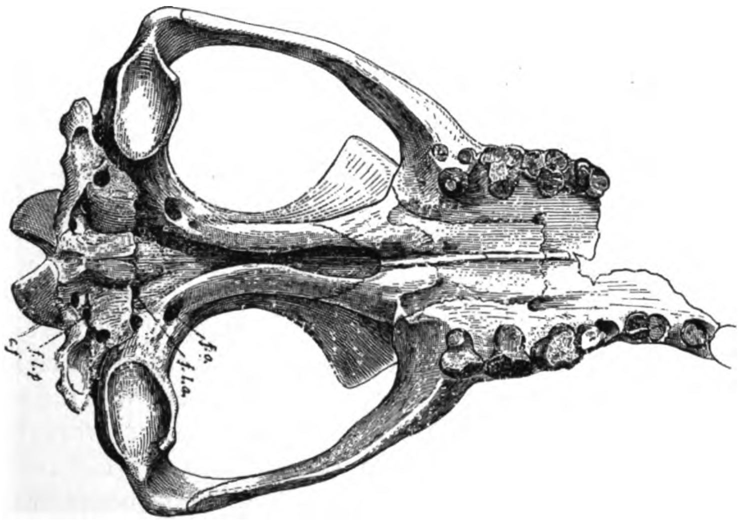


FIG. 12. SKULL OF MESONYX

Upper Eocene of Utah. After Osborn

the upper jaw these are in a triangle, one cusp inside, two outside; in the lower jaw they are in series, the central one being much the highest.

The Mesonychidæ are found in all the Eocene strata from the oldest to the youngest, and show a series illustrating the gradual evolution of their peculiar type of tooth. The massive blunt-cusped teeth, generally very much worn, suggest that they were used for crushing bones or other hard food, and that the animal fed upon carrion, like the modern hyæna. (See Fig. 1.)

B. FISSIPEDIA, OR TRUE CARNIVORA.

There are seven [1] families of living Carnivora, four of which are cosmopolitan, being found in all the continents except Australia, while one (the Raccoons) is peculiar to America, and two (the Civets and the Hyænas) are peculiar to the Old World. The families are:

1. URSIDÆ, or Bears (Black Bear, Grizzly, Polar Bear etc.).
2. PROCYONIDÆ, or Raccoons (Raccoon and some rarer animals).
3. CANIDÆ, or Dogs (Wolves, Foxes, Jackals).
4. VIVERRIDÆ, or Civets (Civet, Mongoose etc.).
5. MUSTELIDÆ, or Mustelines (Weasel, Otter, Badger, Skunk etc.).
6. FELIDÆ, or Cats (Lion, Tiger, Leopard, Puma, Lynx etc.).
7. HYÆNIDÆ, or Hyænas.

The predaceous animals of Australia and the islands near to it are all Marsupials, or Pouched Mammals, except a wild Dog which was probably introduced by man. The range of the families of true Carnivora in former geological epochs was the same as now, except that South America had no true Carnivores until the Pliocene epoch, their place being taken by carnivorous Marsupials related to those which still inhabit Australia. In general the fossil true Carnivores are placed without difficulty in one or another of the families still surviving; but the earliest known ancestors of all these families were so much alike that it is hardly possible to say in which family they should be placed, and they are conveniently grouped together under the name of VIVERRAVIDÆ, or Ancient Civets, as the Civets among all the modern Carnivores are least altered from the primitive stock. As time went on these primitive Carnivora became more clearly differentiated, so that in the Miocene epoch all the modern families are easily distinguishable. (See Fig. 8.)

[1] Besides these seven families there are a few rare and peculiar Carnivora which are placed in families by themselves, but these are of no geological importance and need not be considered here.

URSIDÆ, OR BEARS.

The Ursidæ, or Bears, are the largest living Carnivora, and are not exceeded in size by any one of the extinct forms. They are less strictly carnivorous than most of the others, since they live in large part upon berries, nuts, roots and other vegetable food. The Polar Bear is an exception, feeding entirely upon animal food, fish and seals. Skulls of two extinct bears are shown in the collection, the Californian and European Cave-Bears.

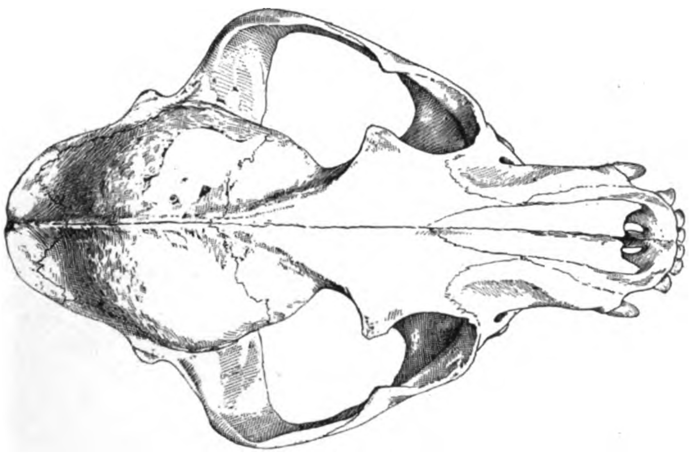


FIG. 13. TOP VIEW OF SKULL OF PHLAOCYON
A link between raccoons and primitive dogs. Lower Miocene of Colorado. Natural size

These get their name from the fact that their remains are chiefly found in caves, where they hibernated, probably, during the cold season, as do modern bears.

PROCYONIDÆ, OR RACCOONS.

The Procyonidæ are found only in North and South America, with the exception of the Panda of India, which is doubtfully referred to this family. Fossil raccoons very much like the living species are found in the Pleistocene strata of various parts of the United States, and in cave deposits. In the Oligocene and Miocene epochs lived two more primitive genera which

illustrate the evolution of these animals from the primitive civet-like Carnivora of the Eocene epoch. The Miocene stage, *Leptarctus*, is very little known; only a lower jaw and an upper tooth have been found. Of the Oligocene stage, *Phlaocyon*, a nearly complete skeleton was found in 1898, of which the skull, jaws, limbs and feet are on exhibition. This unique specimen is one of the best preserved fossil Carnivores in the collection. It is intermediate between the civet-like ancestors of the dogs (*Daphœnus* and *Cynodictis*) and the modern raccoons. The

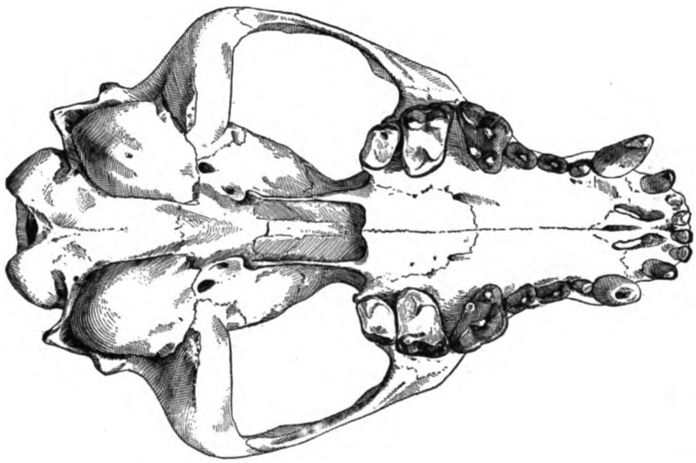


FIG. 14. UNDER SIDE OF SKULL OF PHLAOCYON

A link between raccoons and primitive dogs. Lower Miocene of Colorado. Natural size

shape of the skull is raccoon-like, but the number of teeth is the same as in the dogs, while their form is intermediate between the two types. The limbs and feet are also intermediate. It is probable, therefore, that the Dogs and Raccoons are derived from a common ancestral stock. Specimens found in Europe indicate that the Bears are likewise derived from this common stock, and that the three families have diverged, the Dogs becoming terrestrial flesh-eaters, living largely in open country, the Bears omnivorous and living in the woods, the Raccoons omnivorous and arboreal.

Canidæ, or Dogs.

The living species of Canidæ—Wolves, Coyotes, Foxes—are found only in the most recent deposits (Pleistocene). A great variety of extinct species is known, some of which are the ancestors of modern forms, while others belong to side branches which have not survived. Most remarkable of these side branches were the Amphicyons or Bear-like Dogs, some of which were of huge size, equalling the modern Polar Bear—see skull and backbone of *Dinocyon* in wall-case No. 8. A large series of skulls of vari-

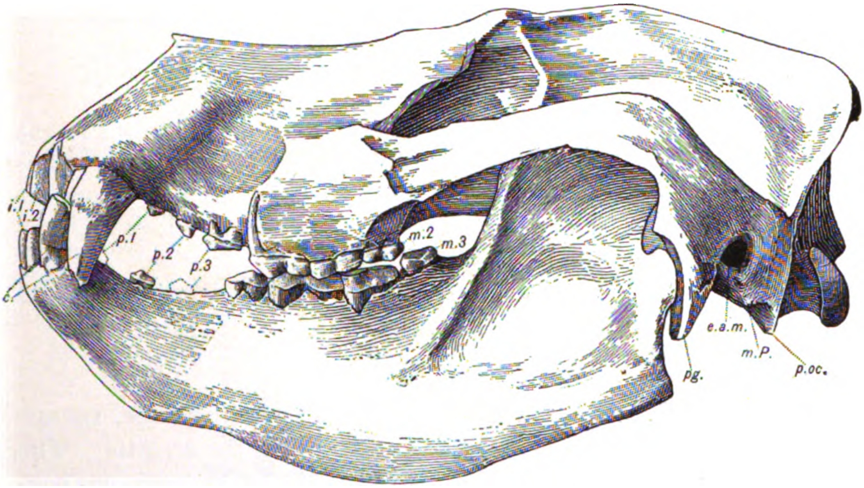


FIG. 15. SKULL OF DINOCYON
A gigantic extinct dog from the Upper Miocene of Texas. One-fourth natural size

ous extinct Dogs of the Oligocene and Miocene epochs is shown in the table-case. These indicate the evolution of the modern species from animals much more like the Civets in proportions and in the character of their teeth. It has been possible to trace out the probable direct lineage of at least two of the modern dogs, the Dhole of India, and certain South American foxes, through these North American fossil species. Other fossil species belong to races of Canids now extinct.

The increase in brain capacity from ancient to modern animals is well shown in this series of skulls. All ancient Dogs had small brains of inferior organization to their modern descendants.

VIVERRAVIDÆ.

Type: *Viverravus*, skull etc. Table-case.

The Viverravidæ resemble the modern Civets more nearly than any other modern Carnivora. They differ from them in fact in various primitive characters not very noticeable. The brain-case is much smaller in proportion; the scaphoid and lunar bones are sometimes not united; but the form and number of the teeth and proportions of the body were not different from those of modern Civets, except that the skull was larger and the limbs were shorter. They were probably the ancestors of the modern Carnivora, except the Cat family. (See Fig 8.)

VIVERRIDÆ, OR CIVETS.

A few specimens of fossil Civets from Europe are shown in the collection. They are not found fossil in America, but it is probable that they are descended, without much change in character, from the Viverravidæ shown in the opposite side of the same table-case.

MUSTELIDÆ. OR MUSTELINES.

Types: *Bunælurus*, *Plesictis*, *Mustela*, *Conepatus*, skulls.

The Mustelines are mostly small or of medium size, savage and blood-thirsty, solitary and forest-loving or aquatic. The Otters are aquatic and live mainly on fish; the Badgers are burrowing animals, and live mainly on burrowing rodents etc.; the Martens, Ferrets and Skunks are arboreal and terrestrial.

These different kinds of Mustelines seem to have separated as early as the Oligocene epoch, for even then we find Martens, Skunks and Otters distinguishable. But they were much more alike then than now, and all of them have many characters linking them with the Civets, indicating that the two families had a common origin. Compare the difference in teeth between *Bunælurus* and *Potamotherium* with the difference between their modern descendants the Marten and the Otter; also compare the *Bunælurus* teeth and skull with those of a civet. Note also the comparatively small brains of the Oligocene Mustelines as *Bunælurus* and *Plesictis*. Their Miocene descendants (*e. g.*, *Mustela ogygia*

skull) had larger brain capacity, and the modern forms still larger and better-developed brains. This indicates that slow but steady

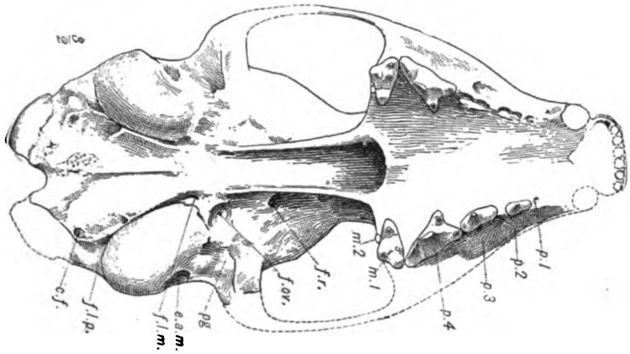


FIG. 16. SKULL OF THE PRIMITIVE MUSTELINE BUNÆLURUS

Oligocene of Colorado. Three-halves natural size. Viewed from the under side to show the teeth

increase in intelligence which has occurred in almost all the lines of evolution among quadrupeds. *Superiority of brain is the final test by which, in the long run, the persistence of a race is decided.*

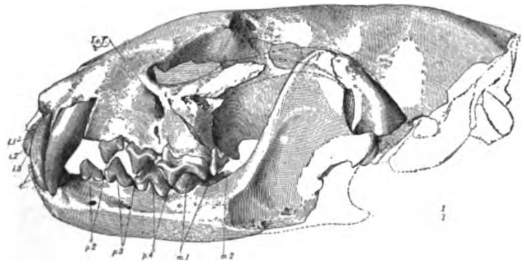


FIG. 17. SKULL OF MUSTELA OGYGIA

An extinct species of marten, from the Middle Miocene of Colorado. Side view, natural size

Felidæ, or Cats.

(Sabre-Tooth Tigers)

Types: the mounted skeletons of *Smilodon* and *Hoplophoneus*, skeleton of *Dinictis* in block, skulls of *Hoplophoneus*, *Dinictis*, *Archælurus*.

Almost all the fossil Cats belong to a division now extinct, in which the upper canine teeth were enlarged into great curving, flattened, sharp-edged tusks, sometimes seven inches long.

Smilodon of the Pleistocene epoch was as large as a polar bear, and exceedingly muscular, especially in the great massive fore-limbs. The claws in the mounted skeleton (upright case) are larger than the largest lion claws. One of the great tusks is complete, the other was broken off during the lifetime of the

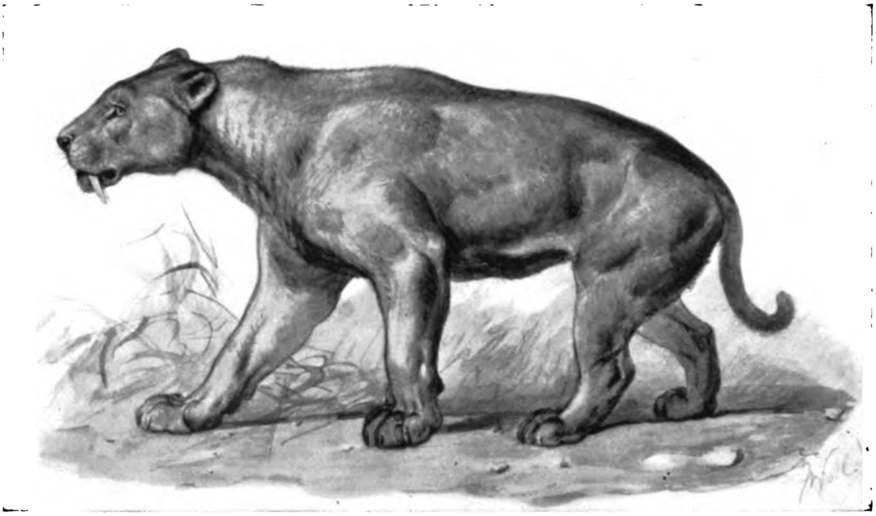


FIG. 18. THE GREAT SARBE-TOOTH TIGER, SMILODON
Pleistocene of South America. Restoration by Wolff. Courtesy of Dr. Elliott

animal, for the stump shows evidence of considerable wear after it was broken. This skeleton was found near Buenos Aires in Argentina along with the remains of gigantic ground-sloths (*Megatherium*) and tortoise-armadillos (*Glyptodon*) which may well have been the prey of this most terrible of all the Carnivora. But the Smilodons ranged all over the New World, and like the nearly allied *Machærodus*, which was distributed over all the northern continents, were contemporaries of primitive man. Whether our palæolithic ancestors ventured to contend with this gigantic foe, we do not know, but the structure of its skeleton indicates that, although more powerful than the lion and the

tiger, it was not nearly so active and intelligent, and that it was fitted to prey upon the slow-moving giant pachyderms of the Quaternary rather than upon active, alert and intelligent animals, least of all perhaps upon man. In the extinction of the Sabre-Tooth Tiger we may rather regret the passing away of a singular and magnificent type of the beasts of prey than rejoice over the disappearance of a dangerous enemy to the human race.

The ancestral Sabre-Tooth Tigers of the older geological epochs were smaller and less specialized. The skeleton of *Hop-*

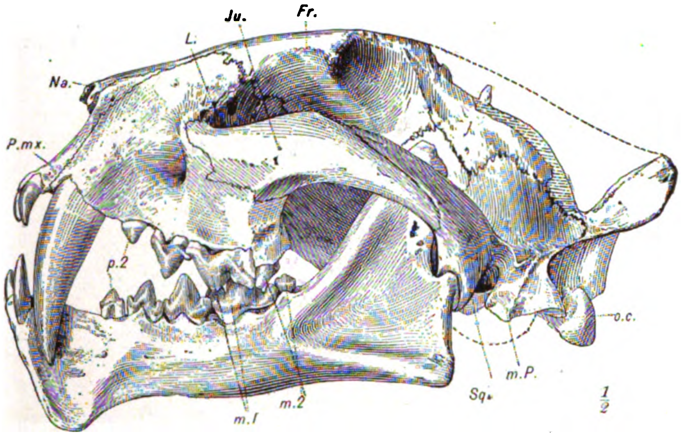


FIG. 19. SKULL AND LOWER JAW OF DINICTIS
Primitive Sabre-Tooth Tiger from the Oligocene of Colorado. One-half natural size

lophoneus illustrates their general character and size. This is the most perfect specimen in the collection, every bone being present, and all, with a few unimportant exceptions, complete and perfectly preserved. *Hoplophoneus* was proportioned somewhat like a leopard, but with shorter smaller limbs and very short spreading feet. *Dinictis* had longer limbs, but the teeth were less specialized. *Archælurus* and *Nimravus* were more primitive types, linking the Sabre-Tooth with the ancestors of the true Cats.

Habits of the Sabre-Tooth Tigers. The modern great Cats kill their prey usually by biting it in the neck so as to break the spinal column. They pursue as a rule the long-necked, thin-skinned

ruminants, which are the most abundant herbivores of to-day, seldom molesting the short-necked, thick-skinned pachyderms such as the rhinoceros and the elephant. The Sabre-Tooth appears to have used his great canine fangs in a quite different method of attack; the whole structure of the animal indicates that he struck them forcibly into the side of his prey, the mouth gaping wide meanwhile, and then presumably withdrew them with a ripping, tearing stroke, leaving a great gash whereby a

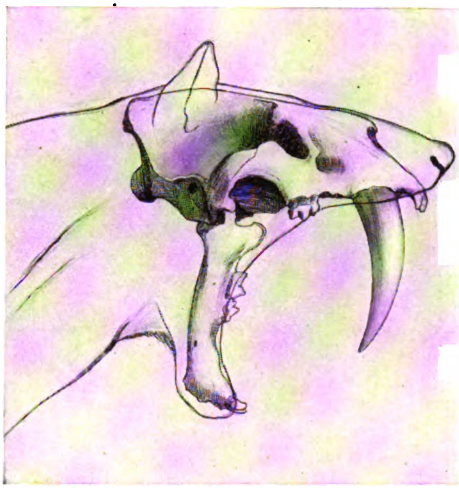


FIG. 20. THE HEAD OF SMILODON. OUTLINE RESTORATION
To show the widely gaping jaw. By Chas. R. Knight

large animal would soon bleed to death. By this method he would be peculiarly fitted to attack the great pachyderms, with which his exceptional muscular strength especially fitted him to cope while his lack of speed and agility would render him much less dangerous to the swift-footed ruminants and horses of the time. We may infer therefore that, while the true Cats were evolved to prey upon the larger swift running quadrupeds and developed speed and agility to catch their prey, the Sabre-Tooth was evolved to prey upon the powerful and massive contingent of the Herbivora, and developed enormous muscular strength and peculiar weapons of attack to cope with these animals.

The true Cats are not common as fossils, and our collections

contain only a few fragmentary specimens. They can be traced back as far as the Oligocene epoch, without any great change in character, but their earlier history is a blank. It appears probable that they are derived along with the Sabre-Tooth Tigers from some undiscovered group of Creodonts more nearly related to *Palæonictis* than to any other known fossil type.

Hyænidæ, or Hyænas.

Fossil Hyænas are common in the cave deposits of the Old World, but none have been found in this country. In the older formations of Europe there has been found a series of extinct forms which appear to connect the Hyænas with primitive Civets (*Ictitherium*, *Palhyæna*). These are not represented in our collections.

C. PINNIPEDIA, OR SEALS.

This group of Carnivora is exclusively adapted to marine life. They are found fossil in sediments of marine origin, but are very rare, and nothing is known of their evolution. They are almost unrepresented in our collections. An incomplete skull of an extinct species of Walrus found near Atlantic City, N. J., shows that the range of this animal formerly extended much farther south than now.

II. CHIROPTERA, OR BATS.

The Bats are the only mammals capable of true flight, although there are certain kinds of squirrels, marsupials and the so-called "flying lemurs," which can extend portions of the skin into a sort of parachute to assist them in taking long leaps from bough to bough. The wings of Bats are chiefly an extension of the skin membrane between the fingers, which are greatly elongated; those of birds on the contrary are chiefly composed of feathers which grow from the whole length of the arm and hand, although mainly from the second digit of the hand.

Fossil remains of Bats are exceedingly rare except in cave deposits, and do not teach us much about the evolution of this singular group of mammals. They resemble the Insectivora more than any other

order in teeth and skull, but we know practically nothing of when or how the great wing-membranes were developed, except that they must have been of very ancient origin, for in the Oligocene epoch this feature was as fully formed as now. A few fragmentary jaws and wing bones are shown in the collection.

III. INSECTIVORA.

Hedgehogs, Moles, Shrews etc. Table-case.

Small mammals of rather inferior organization with claws on the toes five digits on each foot, simple teeth with sharp cusps on the crowns and no gnawing teeth.

The Insectivora are an order of animals defeated and disappearing in the struggle for existence, owing to the superior

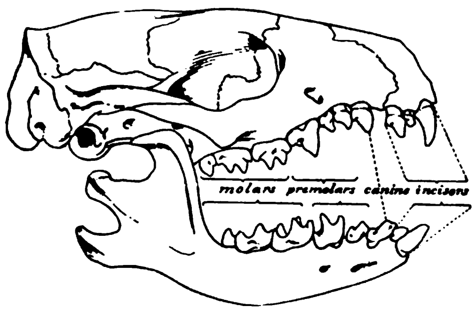


FIG. 21. SKULL OF THE HEDGEHOG.
A surviving type of the insectivora. Natural size

intelligence or better adaptation of their competitors. To escape utter destruction they have been forced into one or another peculiar mode of existence or method of defense, or have been driven to take refuge in the remoter corners of continents or in oceanic islands, where competition is less severe. The Hedgehogs have survived by virtue of their stout and efficient prickly coat, which deters almost any carnivorous animal from meddling with them. The Moles have taken refuge in the earth, where their rivals are few, and they are out of reach of most enemies. The Shrews are partly protected by their unpleasant odor, partly by their small size, nocturnal habits and burrowing or otherwise

concealing themselves. The other Insectivora are inhabitants of the larger tropical islands—Cuba, Madagascar and some East Indian islands—or of South Africa, but have disappeared from the great northern continents, Europe, Asia and North America, where the struggle for existence has been most severe and where all the higher types of mammals have been evolved.

The Insectivora are a very ancient order of mammals, and in past geological periods they were of more importance than now; in fact they have been considered by many scientists as representing more nearly than any other living order the primitive central group from which all other mammals have descended. Through the "Age of Mammals" they progressed less than most other orders and several families of them became extinct during that time, while the Moles and Shrews diverged from nearly similar habits to their present peculiarities, and the Hedgehogs, probably, acquired their coat of spines.

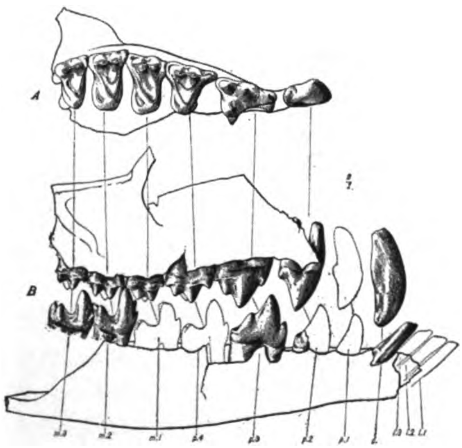


FIG. 22. ICTOPS ACUTIDENS
Upper and lower teeth, showing the "tritubercular" molars. Oligocene Epoch, Montana.
Twice natural size

Lepticidæ, or Primitive Hedgehogs. Extinct.

Tritubercular molar teeth. Two incisors in upper dentition. Premolars unreduced, the last one molariform. Tibia and fibula fused, ulna and radius separate. Size and proportions like the modern

Hedgehog, skull long and pointed. Eocene and Oligocene epochs, North America.

A series of skulls of these little animals is shown in the table case. They differ from the true Hedgehogs in many archaic characters and there is no reason to suppose that they wore a prickly coat. The "tritubercular" teeth are a primitive characteristic.

ERINACEIDÆ, OR HEDGEHOGS. Living.

Quadritubercular molar teeth. Three incisors in upper dentition. Premolars often small, sometimes reduced in number, the last one molariform. Tibia and fibula united, ulna and radius separate. Skull rather short in the Hedgehog, long and pointed in certain allied East Indian animals. Oligocene to Recent epochs, Europe and America.

Part of the skull of a true Hedgehog of an extinct genus, *Proterix*, from the Oligocene of South Dakota, is shown in the table case, besides jaws of the Miocene genus *Galerix* from Europe.

TUPAJIDÆ, OR TREE-SHREWS.

Living. Borneo.

MACROSCELIDÆ, OR JUMPING-SHREWS.

Living. Africa.

SORICIDÆ, OR SHREWS.

Living. Europe, Asia, northern Africa and North America.

Incisors and premolars reduced in number, the incisors forming a pair of sharp-pointed pincers, molars quadritubercular. No zygomatic arch. Oligocene to Recent. Europe and North America.

More than half of the species of living Insectivora come under this family, but all are of small size, mostly nocturnal, hiding in burrows or beneath leaves or roots during the day. They feed on insects, for which purpose the pincer-like incisors and the sharp little cusps of the molar teeth are well adapted. Fossil Shrews are found in the Oligocene and later formations of both Europe and North America, but only fragmentary remains have been discovered. A few are on exhibition.

TALPIDÆ, OR MOLES.

Living. Europe, Asia, northern Africa and North America. Eocene to Recent in Europe and North America.

Completely subterranean; fossorial or burrowing. Incisors not pincer-like. A zygomatic arch present. Fore-limb very short and powerful, specialized for digging.

A small skull of a primitive Mole, *Proscalops*, from the Miocene of Colorado is on exhibition. It is Shrew-like in several respects, showing an approach between the now distinct families of Moles and Shrews. Other fragmentary remains of Moles are shown.

POTAMOGALIDÆ.

Living. Madagascar and West Africa. Aquatic animals with long eel-like tails.

SOLENODONTIDÆ.

Living. Cuba and Hayti.

CENTETIDÆ.

Living. Madagascar.

Fossil species supposed to be related to these animals are found in the Eocene (*Centetodon*) and Lower Oligocene (*Microp-*

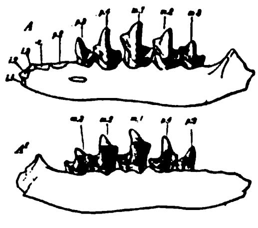


FIG. 23. MICROPTERNODUS BOREALIS
A small and primitive extinct insectivore. Lower jaw, inner and outer view, twice natural size. Oligocene Epoch, Montana

ternodus) of North America. This and the following family are more primitive than any other mammalia in the construction of their teeth.

Chrysochloridæ.

Living. South Africa.

These are known as Cape Golden Moles and take the place of the true Moles in South Africa. A fossil species has been found in the Miocene of Patagonia, indicating that they formerly inhabited both southern continents.

Adapisoricidæ.

Extinct. Lower Eocene. France. Imperfectly known.

Dimylidæ.

Extinct. Lower Miocene. Europe.

Only two molars in upper and lower jaw, the second quite small. Premolars reduced, no canine. Jaws are exhibited in the table-case.

IV. RODENTIA, OR GNAWERS.

Mice, Squirrels, Beavers, Hares, Porcupines etc.

Small mammals with claws on the toes, five digits on each foot, the teeth reduced in number, a pair of upper and lower incisors specialized for gnawing. The gnawing teeth grow continually from persistent pulps, during the lifetime of the animal. They have enamel only on the anterior surface and wear to a chisel-like edge which is continually renewed by the more rapid wear of the dentine behind the enamel.

FIG. 21. SKULL OF THE RAT

The most familiar type of the rodentia. Natural size

The Rodents are the most numerous group of mammals, but they are almost all small. There are probably now more different

species of rodents than of all the other mammals put together, and they are found in all sorts of places; some are terrestrial, others arboreal, others fossorial or subterranean, others amphibious. They live chiefly on vegetable food, such as grasses, fruit and nuts.

During the Tertiary period Rodents were probably equally numerous; but their remains are so small that they are apt to escape the attention of collectors. Even so they are among the most common of fossil mammals. Most of them belong to families still living.

MURIDÆ. Rats, Mice, Muskrats, Meadow-mice etc.

This is the largest group of the Rodents; there are more than 170 recognized species in North America alone. Several species have been found rather abundant in the American Badland formations. In the White River beds, *Eumys*, allied to the White-footed Mouse, is common; *Paciculus*, allied to the Wood-Rat, is found in the John Day beds; Muskrats and Meadow-mice occur in the Pleistocene.

GEOMYIDÆ. Pocket Gophers.

Found only in North America. Fossil Pocket Gophers occur in the John Day and later formations in the Western States.

HETEROMYIDÆ. Pocket Mice.

Found only in North America. Fossil Pocket Mice are rather common in the White River and John Day formations.

SCIURIDÆ. Squirrels, Prairie Dogs, Woodchucks etc.

Fossil Squirrels, not easily distinguishable from the modern forms, are found in the Oligocene and later formations of the United States. Prairie-Dogs occur in the Pleistocene.

HAPLODONTIIDÆ, OR SEWELLELS. Oligocene to Recent.

The Sewellel, or Mountain Beaver, is a peculiar little burrowing Rodent found only in the western Coast Region of North

America. A tiny fossil Rodent, *Meniscomys* of the Oligocene epoch, is thought to be ancestral to it.

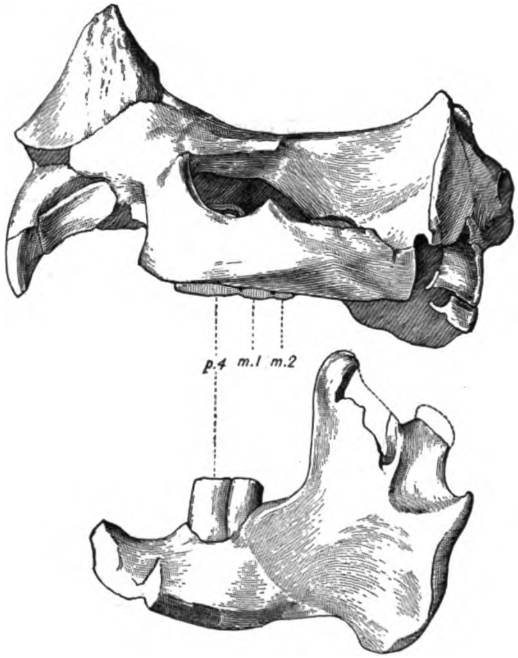


FIG. 25 THE HORNED RODENT, CERATOGAULUS
Skull and lower jaw. Middle Miocene of Colorado. Natural size

MYLAGAULIDÆ. Extinct. Miocene.

Curious little Rodents with digging claws on the fore-feet, very wide short head and peculiar teeth. One skull in the case, the *Ceratogaulus*, or Horned Rodent, shows a large boss indicating a horn on the nose, which gives it an odd likeness to a rhinoceros skull. They are very rare fossils, found only in North America.

CASTORIDÆ. Beavers. Oligocene to Recent.

Fossil Beavers of small size have been found in the Tertiary beds of both America and Europe and several skulls are shown in the collection. In the Quaternary beds are found remains of Beavers scarcely to be distinguished from the living species.

Ischyromyidæ.

Extinct. Eocene and Oligocene.

These were Rodents with teeth more or less like Squirrels, but with skulls more like those of Porcupines and Beavers. They are more ancient than any living rodent families, for they were common in the Lower and Middle Eocene, while no other rodents appear until the Upper Eocene. Several skulls and parts of skeletons of *Ischyromys*, *Paramys* etc. are on exhibition.

Castoroididæ.

Extinct. Pleistocene.

Intermediate between beavers and hystricomorphs, but of very large size. *Castor ohioensis* equalled a black bear in size. A skull and jaw of this rare animal are shown in wall case No. 8. Its remains are usually found in bogs, along with those of the mastodon.

South American Rodents.

All the extinct and most of the living Rodents of South America belong to a division more nearly related to the porcupine than to anything else. Some of the living ones, as the Paca and Capybara are of quite large size.

A series of skulls and jaws of extinct rodents from the Miocene of South America is exhibited in the table-case.

There are certain extinct European Rodent families which are thought to be more nearly related to the South American Rodents than to any others, and the remains of several of these forms are exhibited in the case for comparison beside them.

Leporidæ. Hares and Rabbits.

In the White River Badlands remains of fossil Hares are very abundant. They are more primitive than the modern species in the construction of the teeth, and are placed in the genus *Palæolagus* ("Ancient Hare"). In the later formations of America the rabbits belong to the modern genus *Lepus*.

LAGOMYIDÆ. Picas, or Tailless Hares.

These are little animals looking like small Rabbits, but have fewer teeth. They are found in high mountain regions in the Old World and likewise in western North America. They have

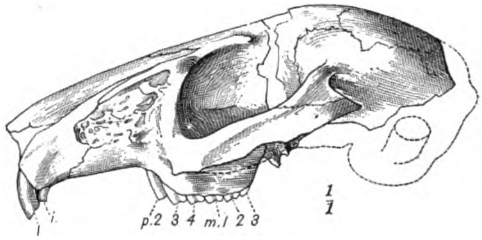


FIG. 26. SKULL OF PALÆOLAGUS
An ancestor of the hares. Oligocene of Colorado. Natural size

been found fossil in Europe, but in America occur only in the latest geological epoch; in the Old World they seem to have taken the place of the true Hares, which were limited to the New World until the end of the Tertiary period.

V. MARSUPIALIA.

All the living marsupials are inhabitants of Australia and the adjacent islands, except the Opossums and a rare genus of Rat-

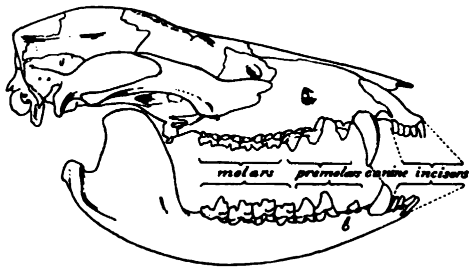


FIG. 27. SKULL OF THE OPOSSUM
Shows the peculiar dentition of the marsupials. Half natural size

Kangaroos from South America. In Australasia they take the place of the mammals of the other continents, none of which occurs

there.[1] Fossil marsupials related to the existing ones of the same region are found in Australia; one gigantic extinct Wombat, *Diprotodon*, is shown in case 6. In South America in the Miocene strata are found remains of various carnivorous marsupials and also of Rat-Kangaroos; a skull and other materials are shown in the collection. In the Eocene and Oligocene of Europe and North America, are found small jaws scarcely to be separated from those of the Opossum except by size. The primitive trituberculates of the Cretaceous period, in the table-case, may also have been marsupials.

VI. MULTITUBERCULATES.

This ancient group of mammals lived during the Age of Reptiles, and became extinct at the beginning of the Age of Mammals. Only jaws, teeth and other fragmentary remains have been found, and it is quite uncertain whether the group is related to the Marsupials or to the Monotremes (*Ornithorhynchus* etc.). Some resemble the Marsupial Rat-Kangaroos, others mimic the Rodents in form. The largest and best known is *Polymastodon* of the basal Eocene; the oldest shown in the case is the tiny *Ctenacodon* of the Jurassic period. *Chirox* and *Ptilodus* of the Cretaceous and basal Eocene are most like the Rat-Kangaroos.

VII. MESOZOIC TRITUBERCULATES.

A number of very small and fragmentary jaws and teeth of Trituberculates from strata of the Jurassic and Cretaceous periods of the Age of Reptiles are exhibited here. They are interesting because they are the most ancient of mammals and show the method of their evolution from reptilian ancestors. Some are thought to be related to the Marsupials, others more nearly to the Insectivores, but until more perfect specimens are found, little can really be stated with certainty about them. Enlarged models of three of these specimens are shown in the case, besides casts and original specimens of many more.

[1] The only exceptions are the dingo, or wild dog, which was probably introduced by man and a few small rodents and bats.

The *Dromatherium* and *Microconodon* casts and models represent two little jaws which are the oldest mammals known. They were found in the Triassic coal-beds of North Carolina, and have a type of teeth intermediate between the primitive three-cusped form of mammals and the simple one-cusped tooth of Reptiles.

THE ORIGIN OF MAMMALS.

The several groups of small and mostly primitive mammals which we have gone over in this guide-leaflet furnish a great deal of evidence, direct and indirect, as to the characters and appearance of the ancestral group or groups from which all mammals are supposed to be descended.

The most ancient mammals, the Multituberculates and Mesozoic Trituberculates of the Age of Reptiles, are known only from rare and very fragmentary remains and many more or less contradictory hypotheses have been advocated as to the relations of these little known groups to the Tertiary mammals which succeeded them and to the lower vertebrates (reptiles and amphibians) which preceded them in geological history. The consensus of present opinion is that mammals in general evolved from an unknown stock of reptiles most nearly related to the Theriodontia[1] which flourished at the end of the Palæozoic era; that they soon split into two branches, one of which (Monotremes) survives without very great change in the egg-laying mammals of Australia. The other more progressive branch again split, one division giving rise to the Marsupials, the other to the Placentals, the latter including all the remaining groups of mammals. The Multituberculates represent a side branch, but whether of Marsupials or of Monotremes is uncertain. The Trituberculates of the Mesozoic era were more nearly in the direct line; some appear to be in the Marsupial branch, others more doubtfully in the Placental branch. But all these conclusions are largely hypothetical.

When we come to the Tertiary mammals, we can speak much more certainly, as these are far more completely known. All the modern races of mammals, as we trace them back towards their

[1] Exhibited in the Hall of Fossil Reptiles, south side.

beginnings, approximate more and more towards a central type which is most nearly represented among known fossils by the earliest Creodonta (Oxyclænidæ) of the dawn of the Tertiary. The Insectivora and Rodentia are also groups of mammals which in most respects have not departed very far from this primitive type. Its general characters are, (1) Small size; (2) Small brain of low organization; (3) Forty-four teeth of simple construction, with sharp cusps, the molars, premolars, canines and incisors of different form, the molars having the "tritubercular" pattern; (4) Limbs and neck flexible and of moderate length, tail very long and powerful, probably prehensile; (5) Feet with five digits on each foot, claws on the toes, the thumb more or less opposable.

These characters appear to indicate an arboreal mode of life rather than any other, and we may suppose that during the Age of Reptiles the ancestors of the mammals were tree-living animals, feeding chiefly upon insects. They were insignificant in size and unimportant in numbers, quite overshadowed by the great and numerous reptilian fauna which flourished during that long era. They possessed, however, the two most important elements of final success in the evolutionary struggle; a brain which, though inferior to that of their descendants, was superior to the brain of all other contemporary vertebrates, and a construction of the joints of limbs and feet more mechanically perfect than in any other animals. By the further improvement and elaboration of these factors of success, they were enabled to displace all their rivals, and become dominant upon land and to some extent upon the sea. Their invasion of the aërial province, already occupied by the highly developed and specialized birds, has been less successful, but of the once dominant reptile fauna of the land, almost nothing remains. The triumphant mammals have branched and re-branched, diverged into countless specializations in adaptation to peculiar modes of life, some of which have survived, while others have become extinct, but always the prime factors of success in the long run have been those which gave them their original advantage over their reptile competitors. Finally the truth that the supremacy in intelligence is first in importance, is best illustrated by the present dominance of man over the whole terrestrial world.

BIBLIOGRAPHY.

This Guide is based principally upon the various scientific studies of specimens in this collection, carried on mostly by members of the staff of this department, which have been published in the Bulletin and Memoirs of the Museum. Upon request, copies of these publications will be loaned to students and others interested in the subject of fossil mammals.

The following books are recommended for collateral reading:

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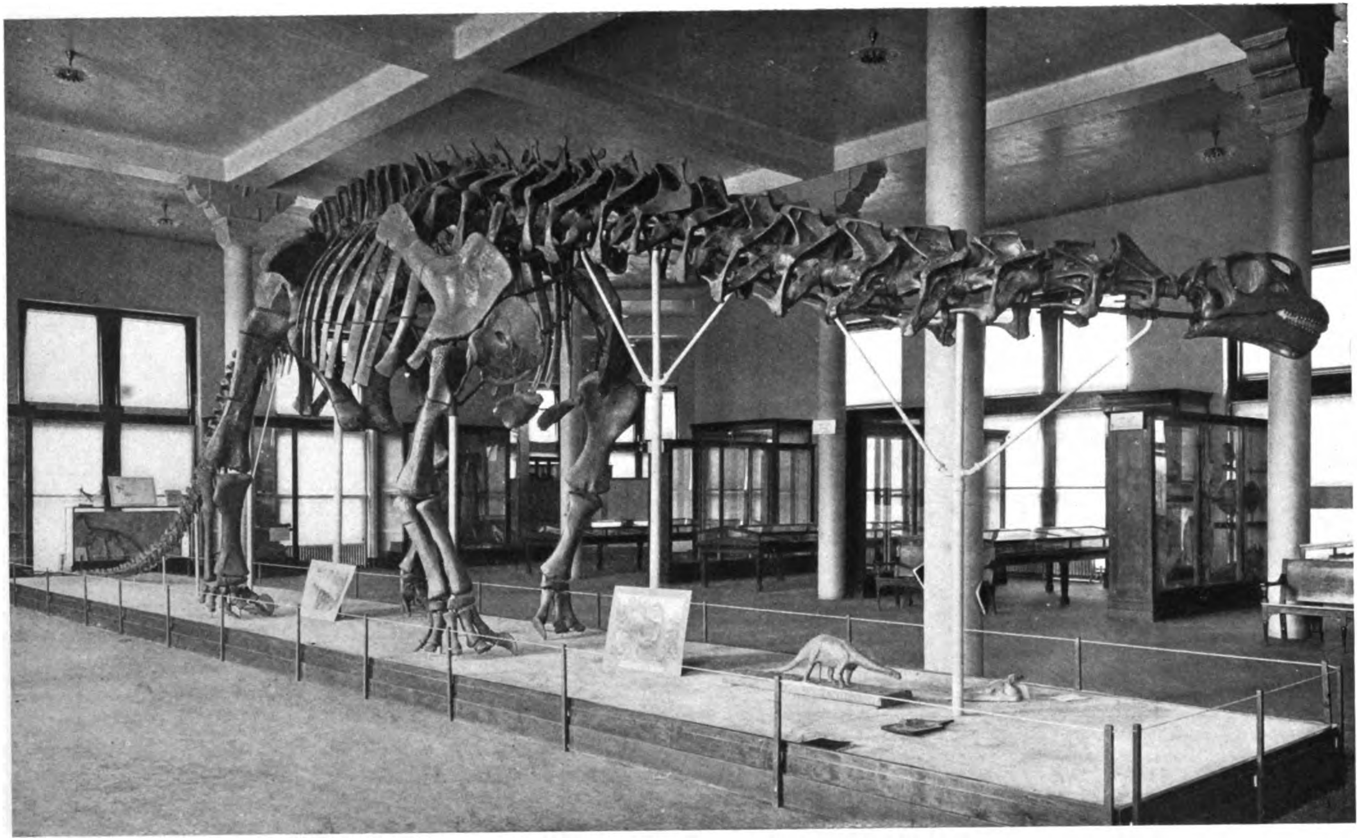

FIG. 1. MOUNTED SKELETON OF BRONTOSAURUS IN THE AMERICAN MUSEUM OF NATURAL HISTORY

The American Museum Journal

VOL. V. APRIL, 1905. No. 2

THE MOUNTED SKELETON OF BRONTOSAURUS.

BY W. D. MATTHEW.

EIGHT years ago the American Museum began a search for fossil reptiles in the Rocky Mountain States. The prime object of the search was to obtain skeletons of the Dinosaurs, those gigantic extinct animals whose fragmentary remains, discovered in that region and studied and described especially by the late Professor Marsh, have excited the greatest interest among men of science. In order to place these marvels of an antique world before the public in tangible form, a Dinosaur Hall was planned, in which should be exhibited mounted skeletons of the principal kinds of Dinosaurs. To obtain these, a series of expeditions into the regions of the arid West, where such fossils are to be found, was inaugurated and carried on under direction of Professor Osborn, and the collections of the late Professor Cope, containing three splendid skeletons of Dinosaurs, were purchased through the liberality of President Jesup.

This programme involved an amount of work hardly to be appreciated by outsiders, and it is as yet far from being complete. Nevertheless, the mounting of the largest skeleton, the Amphibious Dinosaur Brontosaurus, has been finished, the skeleton of a remarkable dwarf Dinosaur, the "Bird-Catcher," has been mounted and placed on exhibition, the preparation and mounting of entire skeletons of three other large and very extraordinary types (the Carnivorous, Duck-billed and Armored Dinosaurs) are well under way, and diligent search is being made for complete and mountable skeletons of other important kinds. Many other more fragmentary specimens have been found, some of which are exhibited in the wall-cases around the hall.

Visitors see here the largest fossil skeleton that has ever been mounted, and may obtain some idea of the variety and the extraordinary character of the animals which populated the earth during the Age of Reptiles, millions of years ago, before the Age of Mammals had begun or the various races of quadrupeds which now inhabit the world had commenced their evolution.

The Brontosaurus skeleton, the principal feature of the hall, is sixty-six feet eight inches in length, and stands fifteen feet two inches high. Its petrified thigh-bone weighs 570 lbs. The weight of the animal when alive is estimated at not less than ninety tons. About one-third of the skeleton, including the skull, is restored in plaster, modeled or cast from other incomplete skeletons. The remaining two-thirds belong to one individual, except for a part of the tail, one shoulder-blade and one hind limb, supplied from another skeleton of the same species.

The skeleton was discovered by Mr. Walter Granger, of the Museum expedition of 1898, about nine miles north of Medicine Bow, Wyoming. It took the whole of the succeeding summer to extract it from the rock, pack it and ship it to the Musuem. Nearly two years were consumed in removing the matrix, piecing together and cementing the brittle and shattered petrified bone, strengthening it so that it would bear handling, and restoring the missing parts of the bones in tinted plaster. The articulation and mounting of the skeleton and modeling of the missing bones took an even longer time, so that it was not until February, 1905, that the Brontosaurus was at last ready for exhibition.

It will appear, therefore, that the collection, preparation and mounting of this gigantic fossil has been a task of extraordinary difficulty. No museum has ever before attempted to mount so large a fossil skeleton, and the great weight and fragile character of the bones made it necessary to devise especial methods to give each bone a rigid and complete support, as otherwise it would soon break in pieces from its own weight. The proper articulating of the bones and the posing of the limbs were equally difficult problems, for the Amphibious Dinosaurs, to which this animal belongs, disappeared from the earth long before the dawn of the Age of Mammals, and their nearest relatives, the living

lizards, crocodiles, etc., are so remote from them in either proportions or habits that they are unsatisfactory guides in determining how the bones were articulated, and are of but little use in posing the limbs and other parts of the body in positions that they must have taken during life. Nor among the higher

FIG. 2. SKELETON OF BRONTOSAURUS IN THE QUARRY

Showing three sections of the backbone partly covered with plaster bandages for transportation to the Museum. The ribs have already been removed from the near side of the backbone. Tools used in the work lie scattered about the quarry.

animals of modern time is there one which has any analogy in appearance or habits of life to those which we have been obliged by the study of the skeleton to ascribe to the Brontosaurus.

As far as the backbone and ribs were concerned, the articulating surfaces of the bones were a sufficient guide to enable us to pose this part of the skeleton properly. The limb-joints, however, are so imperfect, that we could not in this way make sure of having the bones in a correct position. The following method, therefore, was adopted:

A dissection and thorough study was made by the writer, with the assistance of Mr. Granger, of the limbs of alligators and

other reptiles, and the position, size and action of the principal muscles were carefully worked out. Then the corresponding bones of the Brontosaurus were studied and the position and size of the attachments of the corresponding muscles were marked out, so far as they could be recognized from the scars and processes preserved on the bone. The Brontosaurus limbs were then provisionally articulated and posed, and the position and size of each muscle were represented by a broad strip of paper extending from its origin to its insertion. The action and play of the muscles on the limb of the Brontosaurus could then be studied, and the bones adjusted until a proper and mechanically correct pose was reached. The limbs were then permanently mounted in these poses, and the skeleton as it stands is believed to represent, as nearly as study of the fossil enables us to know, a characteristic position that the animal actually assumed during life.

The Brontosaurus was one of the largest of the Amphibious Dinosaurs or Sauropoda, a race of gigantic reptiles which flourished during the Jurassic or Middle Period of the Age of Reptiles, —some eight millions of years ago by a moderate estimate of geological time. These Amphibious Dinosaurs are more ancient than any of the extinct mammals in the adjoining hall (No. 406), except for a few tiny jaws in the Small Mammal Alcove. They were the largest animals that ever lived, excepting some of the whales, and certainly were the largest animals that ever walked on four legs.

In proportions and appearance the Brontosaurus was quite unlike any living animal. It had a long thick tail like the lizards and crocodiles, a long flexible neck like an ostrich, a thick, short, slab-sided body and straight, massive, post-like limbs suggesting the elephant, and a remarkably small head for the size of the beast. The ribs, limb-bones and tail-bones are exceptionally solid and heavy; the vertebræ of the back and neck, and the skull, on the contrary, are constructed so as to combine the minimum of weight with the large surface necessary for attachment of the huge muscles, the largest possible articulating surfaces, and the necessary strength at all points of strain. For this purpose they are constructed with an elaborate system of

braces and buttresses of thin bony plates connecting the broad articulating surfaces and muscular attachments, all the bone between these thin plates being hollowed into a complicated

FIG. 3. MODEL OF BRONTOSAURUS. BY CHARLES R. KNIGHT, 1905
Executed from the mounted skeleton, under direction of Professor H. F. Osborn

system of air-cavities. This remarkable construction can be best seen in the unmounted skeleton of Camarasaurus, another Amphibious Dinosaur.

The teeth of the Brontosaurus indicate that it was an herbivorous animal feeding on soft vegetable food. Three opinions as to the habitat of Amphibious Dinosaurs have been held by scientific authorities. The first, advocated by Professor Owen, who described the first specimens found forty years ago, and supported especially by Professor Cope, has been most generally adopted. This regards the animals as spending their lives entirely in shallow water, partly immersed, wading about on the bottom or, perhaps, occasionally swimming, but unable to emerge entirely upon dry land. More recently Professor Osborn has advocated the view that they resorted occasionally to the land for egg-laying or other purposes, and still more recently the view has been taken by Mr. Riggs and the late Mr. Hatcher that they were chiefly terrestrial animals. The writer inclines to the view of Owen and Cope, whose unequaled knowledge of comparative anatomy renders their opinion on this doubtful question especially authoritative.

The contrast between the massive structure of the limb-bones, ribs and tail, and the light construction of the backbone, neck

and skull, suggests that the animal was amphibious, living chiefly in shallow water, where it could wade about on the bottom, feeding on the abundant vegetation of the coastal swamps and marshes, and pretty much out of reach of the powerful and active Carnivorous Dinosaurs which were its principal enemies.

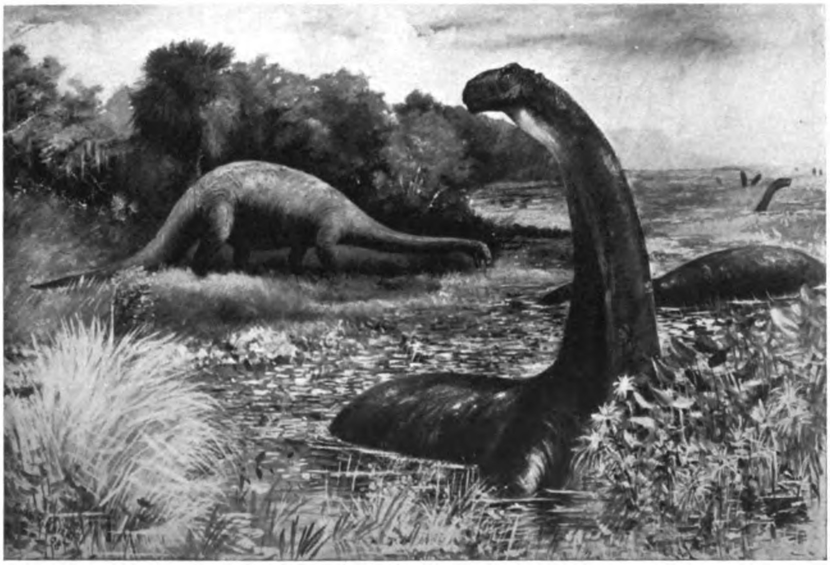

FIG. 4. RESTORATION OF BRONTOSAURUS. BY CHARLES R. KNIGHT
This restoration represents Professor Osborn's view of the habits of the animal

The water would buoy up the massive body and prevent its weight from pressing too heavily on the imperfect joints of the limb- and foot-bones, which were covered during life with thick cartilage, like the joints of whales, seals and other aquatic animals. If the full weight of the animal came on these imperfect joints, the cartilage would yield and the ends of the bones would grind against each other, thus preventing the limb from moving without tearing the joint to pieces. The massive, solid limb- and foot-bones weighted the limbs while immersed in water, and served the same purpose as the lead in a diver's shoes, enabling the Brontosaurus to walk about firmly and securely under water. On the other hand, the joints of the neck and back are exceptionally broad, well-fitting and covered with a much thinner

surface of cartilage. The pressure was thus much better distributed over the joint, and the full weight of the part of the animal above water (reduced as it was by the cellular construction of the bones) might be borne on these joints without the cartilage giving away.

Looking at the mounted skeleton we may see that if a line be drawn from the hip-joint to the shoulder-blade, all the bones below this are massive, all above (including neck and head) are lightly constructed. This line then may be taken to indicate the average water-line, so to speak, of this Leviathan of the Shallows. The long neck, however, would enable the animal to wade to a considerable depth, and it might forage for food either in the branches or the tops of trees or, more probably, among the soft succulent water-plants of the bottom. The row of short, spoon-shaped, stubby teeth around the front of the mouth would serve to bite or pull off soft leaves and water-plants, but the animal evidently could not masticate its food, and must have swallowed it without chewing, as do modern reptiles and birds.

The brain-case occupies only a small part of the back of the skull, so that the brain must have been small even for a reptile, and its organization (as inferred from the form of the brain-cast) indicates a very low grade of intelligence. Much larger than the brain proper was the spinal cord, especially in the region of the sacrum, controlling most of the reflex and involuntary actions of the huge organism. Hence we can best regard the Brontosaurus as a great, slow-moving animal-automaton, a vast storehouse of organized matter directed chiefly or solely by instinct and to a very limited degree, if at all, by conscious intelligence. Its huge size and its imperfect organization, as compared with the great quadrupeds of to-day, rendered its movements slow and clumsy; its small and low brain shows that it must have been automatic, instinctive and unintelligent.

COMPOSITION OF THIS SKELETON.

The principal specimen, No. 460, is from the Nine Mile Crossing of the Little Medicine Bow River, Wyoming. It consists of the 5th, 6th and 8th to 13th cervical vertebræ, 1st to 9th dorsal and 3d to 19th caudal vertebræ, all the ribs, both coracoids, parts of sacrum and ilia, both ischia and pubes, left femur

and astragalus and part of left fibula. The backbone and most of the neck of this specimen were found articulated together in the quarry, the ribs of one side in position, the remainder of the bones scattered around them, and some of the tail-bones weathered out on the surface.

From No. 222, found at Como Bluffs, Wyo., were supplied the right scapula, 10th dorsal vertebra, and right femur and tibia.

No. 339, from Bone Cabin Quarry, Wyo., supplied the 20th to 40th caudal vertebræ; No. 592, from the same locality, the metatarsals of the right hind foot, and a few toe-bones are supplied from other specimens.

The remainder of the skeleton is modeled in plaster, the scapula, humerus, radius and ulna from the skeleton in the Yale Museum, the rest principally from specimens in our own collections. The modeling of the skull is based in part upon a smaller incomplete skull in the Yale Museum, but principally upon the complete skull of *Morosaurus* shown in Case 42.

Mounted by A. Hermann; completed Feb. 10, 1905.

TWO NEW BIRD GROUPS.

THE recently completed group of Flamingos and of the summer bird-life of the San Joaquin Valley of California, photographs of which are reproduced on pages 71 and 77, more closely approach the Museum's ideal of an exhibit illustrating the haunts and nesting-habits of birds than any which have heretofore been prepared.

Both are based upon careful field studies, by artist as well as by ornithologist, and both accurately portray not only the home-life of the species they represent, but also, through the use of a painted background, the character of the region in which the birds live.

Aside from their beauty, which renders them attractive to the most casual observer as well as to the ornithologist, these groups possess much scientific value. This is particularly true of the Flamingo group, in which the nesting-habits of this bird are for the first time properly shown.

These two groups make important additions to the series already prepared through the generosity of several friends of the Museum, who have contributed to a fund designed for this purpose.

By no means the least important feature of the Museum's expedition to the Bahamas in search of material for the Flamingo

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THE FLAMINGO GROUP

Background painted by Charles J. Hittell (landscape) and Louis Agassiz Fuertes (birds). Birds mounted by Herbert Lang

group is the influence exerted by the Museum toward the enactment of a law which has just gone into effect establishing a close season on the Flamingo and other birds which formerly were without legal protection in the colony, and prohibiting the killing of song and insectivorous birds at any season.

MUSEUM NEWS NOTES.

A LARGE part of the Philippine exhibit of the St. Louis Exposition has been acquired by the Museum, subject only to a gift of certain duplicate material to the Smithsonian Institution and to the Commercial Museum of Philadelphia. When packed, ready for shipment, the material thus acquired filled twenty freight cars. All visitors to the exposition will realize that this acquisition is a matter of the highest importance not only to the Museum and to the city, but to the country at large, and that it places here the most comprehensive single collection representing the life and industries of any of the groups of Pacific islands.

The material has arrived at the Museum and a small portion of it has been arranged for temporary exhibition in the North and West Wings of the second floor of the building, but there is material enough to fill an entire wing of the building without duplicating exhibits. The present temporary installation enables the visitor to gain a very good summary idea of the culture of the important tribes inhabiting the islands. Clothing and textile fabrics, household utensils, agricultural implements, fish and game traps, arms, houses, boats and other means of transportation and articles of manufacture, all find their place here in ample illustration. The Museum, furthermore, is exhibiting part of the original material at the Lewis and Clark Centennial Exposition at Portland, Oregon. The Portland exhibit will come to the Museum at the close of the exposition.

J. Pierpont Morgan, Esq., has lately added to the gem collection material representing forty-one mineral species used or available for use as gems. Among the cut stones are some

remarkable rubellites and other California tourmalines, and some choice beryls and topazes. Two superb kunzites, one of 224 karats and the other of 118 karats, add brilliancy to the display of that peculiar new gem. Some new gold specimens are worthy of special mention. The installation of the gem collection has been entirely remodeled, greatly to the improvement of its effectiveness. The floor space of the whole corridor is now devoted to the gems and gem material, each species having a special pedestal case devoted to its proper display. The change in the installation of the gems has necessitated the temporary removal and storage of some of the finest exhibition portions of the mineral cabinet, but they will be displayed again as soon as room can be made for them.

Mr. Morgan has also presented to the Museum the George F. Kunz collection of meteorites, which has been on exhibition for some years as a loan. The collection comprises some rare specimens, including two which are unique and have never been described, and the largest mass (1038 pounds) of Cañon Diablo which has been found.

The mineral cabinet has been enriched by the acquisition of several rarities from the noted Binnenthal locality in the Tyrolean Alps Among the species and varieties received may be mentioned bementite, hutchinsonite, smithite, trechmannite and lengenbachite. A remarkable antique jade labret is one of the recent additions to the collection.

The appearance and usefulness of the local collection of the New York Mineralogical Club have been greatly enhanced by the substitution of neat printed labels for the previous typewritten cards.

The Department of Conchology has received from Mr. F. A. Constable a gift of the last installment of the celebrated Hirase collection of the land shells of Japan, and the series is now on its way to the Museum. This installment comprises about 1000 specimens of shells belonging to 220 species, bringing the total of the Hirase collection in the possession of the Museum up to

about 4000 specimens of 800 species. The series is fully representative of the land molluscan fauna of Japan, and while the specimens are not strikingly beautiful, they are of high scientific interest.

A LARGE proportion of the radium exhibit gotten together for the St. Louis Exposition by the United States Geological Survey has been presented to the Museum and has been temporarily installed in the Hall of North American Mammals (No. 206). The exhibit consists of minerals containing uranium, polonium, radium, actinium and other radio-active minerals; compounds and apparatus illustrating the various steps in the process of manufacture, and photographs and literature bearing upon radio-activity. The principal source of radium is pitchblende from Joachimsthal, Bohemia, but it has also been derived from carnotite, a Colorado mineral, and it occurs widespread in minute quantities. This exhibit attracted great attention at the exposition and is the object of much study by visitors to the Museum.

ANOTHER of the exhibits from the St. Louis Exposition which have been received at the Museum is the material that was sent out by the New York City schools. This exhibit has been temporarily arranged in the East Hall of the second floor (No. 207) and has been visited by thousands of school children and their parents.

A MODEL representing a village of the Koryak tribe of eastern Siberia has been completed by the Department of Ethnology and placed on exhibition in the West Hall of the ground floor. The model represents not only the half-underground houses with their strange hopper-shaped superstructures, but also the industries of the people and the preparation of their store of food for the long winter. The season represented in the group is the autumn.

THROUGH the courtesy of the Oregon Historical Society of Portland, the Museum has had the opportunity of studying, photographing and making casts of an important series of

archæological specimens, mostly from the region between The Dalles and the mouth of the Willamette River. There were fifty-six specimens, comprising implements and other objects in carved stone of several kinds. Such sculptures are rare so far north in America, while several of them are quite unique and are new to archæologists. This loan has enabled the Museum practically to complete its data regarding known specimens from this archæological province.

On February 17 the new Dinosaur Hall of the Department of Vertebrate Palæontology was opened to the public. The principal object in this hall is the great skeleton of Brontosaurus, an enormous herbivorous animal distantly related to the lizards. A detailed description of this specimen, the only exhibit of its kind in the world, is given in another part of the present issue of the Journal. The other great families of dinosaurs (the Carnivorous, the Horned, the Armored and the Spoon-billed) will all be represented in this hall. On the south side of the room have been installed several magnificent specimens of fossil turtles and tortoises from the Cretaceous beds of the West. The specimens for the Dinosaur Hall have been derived from the collections made by the Museum field expeditions from 1897–1904, which have been presented by the Trustees, and the E. D. Cope Collection of Reptiles, Amphibians and Fishes, which was presented to the Museum in 1902 by President Jesup.

The Tower Room has been set aside for the reception of the collection of fossil fishes which is now in process of installation. The principal portions of this collection are the famous Newberry Collection deposited with the Museum by Columbia University; the Cope Collection presented by President Jesup, and an extensive series from Syria.

Over the arch leading into the Morgan Hall of Mineralogy, the Department of Vertebrate Palæontology has installed the giant fish known as *Portheus* from the American Mediterranean Sea of the Cretaceous period.

There has recently been placed on exhibition in the Hall of Fossil Mammals a representative series of the remarkably rich

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THE SAN JOAQUIN VALLEY GROUP
Background painted by Charles J. Hittell (landscape) and Louis Agassiz Fuertes (birds). Birds mounted by H. S. Denslow

extinct fauna collected in caves in Arkansas by Messrs. Walter Granger and Barnum Brown in 1903 and 1904, on expeditions sent into the region by the Museum.

Early in March, Mr. Frank M. Chapman, Associate Curator of Ornithology, went into the swamps of Florida for the purpose of studying the life history of the Brown Pelican and of obtaining additional material for the group illustrating this remarkable bird. He reports exceptional success in attaining the objects of the expedition. He has also obtained data, photographs and specimens with which to represent the nesting-habits of Ward's Heron, the Water Turkey and other birds, greatly enriching our Museum and study collections.

In commemoration of Audubon's one hundred and twenty-fifth birthday, the Museum has placed on exhibition in Hall No. 308, a collection of Audubon relics. Among the objects is the portfolio in which Audubon carried specimen plates while securing subscribers to his great work in this country and abroad, together with sketches and finished plates. Here are also his gun and hunting coat, and the dog harness used in Labrador, mementoes of the journey to the then Far West.

Dr. E. O. Hovey, Associate Curator of Geology, went to Mexico early in February on a geological expedition through the practically unknown Sierra Madre mountain region of western Chihuahua. He reports visiting a wonderful series of cañons, from 2000 to 6000 feet in depth and from 5 to 11 miles in width, which have been carved by the rivers out of the elevated plateaus forming the major portion of the state. Dr. Hovey has also visited the great copper mines at Bisbee, Arizona, and Nacozari and Cananea, Sonora, Mexico. The specimens collected from these mines, as well as from the region traversed in the main expedition, will form valuable additions to our series illustrating economic and mining geology. Hundreds of negatives form an important part of the results of the expedition. Professor Robert T. Hill, formerly of the United States Geological Survey, is the leader of the party.

LECTURES.

MEMBERS' COURSE.

THE second course of lectures to members of the American Museum of Natural History by officers of the scientific staff of the Museum was given according to the following programme:

Thursday evenings at 8.15 o'clock.

February 2.—PROF. A. F. BANDELIER, "The Traveling Indian Medicine Men of Bolivia."

February 9.—PROF. LIVINGSTON FARRAND, "Religious and Ceremonial Life of the North American Indians."

February 16.—PROF. MARSHALL H. SAVILLE, "Ruins of Mayan Cities in Central America."

February 23.—MR. GEORGE H. PEPPER, "Explorations in the Southwest and in Mexico during 1904."

March 2.—MR. GEORGE H. SHERWOOD, "The Game and Food Fishes of Our Atlantic Coast."

March 9.—PROF. WILLIAM MORTON WHEELER, "The Habits of Ants."

March 16.—PROF. ALBERT S. BICKMORE, "Northern Germany—Bremen, Hamburg and Lübeck."

March 23.—PROF. ALBERT S. BICKMORE, "Southern Germany—Stuttgart, Nuremberg and Rothenburg."

PUPILS' COURSE.

DURING the spring and summer terms of the public schools the lectures at the Museum to the pupils have been continued according to the schedule which follows. These lectures, which are intended to supplement the regular grade work in geography are so popular with teachers and classes that it is necessary to use the Auditorium for the whole course. The lecturers are Messrs. L. P. Gratacap, R. W. Tower, W. M. Wheeler, E. O. Hovey, H. I. Smith, G. H. Sherwood, G. H. Pepper and Barnum Brown of the scientific staff of the Museum.

	Mar.	Apr.	May.	
Mon.	6	3	8	"Russia and Japan."
Wed.	8	5	10	"The Capitals of Europe."
Fri.	10	7	12	"The Industries of the United States."
Mon.	13	10	15	"The American Indian."
Wed.	15	12	17	"In Polar Regions."
Fri.	17	14	19	"Spanish America."

	Mar.	Apr.	May.	
Mon.	20	24	22	"The Physical Divisions of the United States."
Wed.	22	26	24	"Egypt and her Neighbors."
Fri.	24	28	26	"Our Island Possessions."
		May		
Mon.	27	1	29	"Methods of Transportation—Past and Present."
Wed.	29	3	31	"The Work of Water."
			June	
Fri.	31	5	2	"New York City—Past and Present."

COLUMBIA UNIVERSITY—MUSEUM COURSE.

During February, Prof. Henry Fairfield Osborn, Curator of Vertebrate Palæontology in the Museum and Da Costa Professor of Zoölogy in Columbia University, delivered a course of six illustrated lectures on "The Evolution of the Horse," in co-operation between the Museum and Columbia University. The programme of the lectures was as follows:

Wednesday, February 1.—"The Horse as an Animal Mechanism."

Adaptation of the teeth, skull, skeleton, musculature and internal anatomy to the special functions of grazing and of speed.

Monday, February 6.—"The Horse in Relation to the Idea of Evolution."

The chief facts in the evolution and geographical distribution and the special relation of horses to their environment.

Wednesday, February 8.—"The Fossil History of the Horse, especially in North America."

Supposed ancestors of the horse in the Cretaceous and Basal Eocene Periods. The first appearance of true horses in the Lower Eocene.

Monday, February 13.—"The Fossil History of the Horse," Continued.

Reasons for believing that the evolution of the true horses has taken place in this country. Causes of the extinction of all the native horses in North and South America.

Wednesday, February 15.—"Existing Races of Horses, Asses and Zebras."

Discussion of the question as to which of these types inhabited North America and the causes of their present distribution in Asia and Africa.

Monday, February 20.—"Probable Origin of the Domesticated Breeds of Horses."

Are domestic breeds of multiple origin? Semi-wild or feral race of horses in different parts of the world. Modes of distribution and intermingling of these breeds. The horse as a factor in civilization.

PEOPLE'S COURSE.

The programme of public lectures given Tuesday and Saturday evenings in co-operation with the Department of Education of the City of New York for the third course of the season 1904–1905 has been as follows:

Tuesdays, a course on European geography:

March 7.—MR. GERHARDT C. MARS, "Venice of the Golden Ring."

March 14.—PROF. H. E. NORTHROP, "Vesuvius and the Bay of Naples."

March 21.—DR. CLARENCE H. YOUNG, "Travels in Greece."

March 28.—MR. HENRY H. PARRY, "Wales and Her People."

April 4.—MR. PETER MACQUEEN, "Scotland."

April 11,—PROF. SUTTON FLETCHER, "Castles and Palace Homes of England."

April 18.—PROF. SUTTON FLETCHER, "The Cathedrals and Abbeys of Britain."

April 25.—MR. ROLAND S. DAWSON, "The St. Louis Expedition."

Saturdays, a course of lectures on sound and music by PROF. E. R. VAN NARDROFF:

March 4.—"Nature of Sound."

March 11.—"Musical Tone and Stringed Instruments."

March 18.—"Sympathetic Tone and Musical Timbre."

March 25.—"Simple Wind Instruments."

April 1.—"Reed Wind Instruments."

April 8.—"Miscellaneous Musical Instruments."

April 15.—"Sound Waves and Musical Harmony."

April 22.—"Telephone and Phonograph."

MEETINGS OF SOCIETIES.

The meetings of the various societies that make the Museum their home have been continued throughout the quarter. Papers on technical and general scientific subjects are read before these societies. The papers and discussions are often of popular character and are always of considerable general interest. The public is invited to attend the meetings, and members of the Museum, on making request of the Director, will be provided with programmes of the meetings as they are published.

The New York Academy of Sciences holds its meetings as follows, at 8:15 P.M.:

First Mondays.—Business meeting and Section of Geology and Mineralogy.

Second Mondays.—Section of Biology.

Third Mondays.—Section of Astronomy, Physics and Chemistry.

Fourth Mondays.—Section of Anthropology and Psychology.

On Tuesday evenings on varying dates meetings are held by the New York Linnæan Society, the New York Mineralogical Club and the New York Entomological Society.

These meetings will continue throughout the month of May and then recess will be taken until October.

As illustrating the wide scope of the work of these societies and the general character of the papers presented at the meetings, we quote the following titles from the monthly bulletins of the Scientific Alliance of New York.

Hofrath Prof. Dr. Albrecht Penck of the Imperial University, Vienna, on "The Glacial Surface Features of the Alps." Illustrated.

Prof. Henry Fairfield Osborn on "Recent Discoveries of Extinct Animals in the Rocky Mountain Region and their Bearings on the Present Problems of Evolution." Illustrated.

Prof. J. J. Stevenson on "Recent Advances in our Knowledge of the Composition of Coal."

Prof. James F. Kemp on "New Sources of Supply of Iron Ore."

Prof. W. M. Wheeler on "Ants that Raise Mushrooms." Illustrated.

Dr. F. A. Lucas on "Whales and Whaling on the Coast of Newfoundland." Illustrated.

Prof. James F. Kemp on "The Physiography of the Adirondacks." Illustrated.

Prof. F. E. Lloyd on "Botanical Research at the Desert Laboratory in Arizona." Illustrated.

Mr. B. S. Bowdish on "Photography in Nature Study." Illustrated.

Mr. Frank M. Chapman on "Florida Bird Life." Illustrated.

Mr. C. G. Abbott on "A Bird-lover in the Scottish Highlands."

Mr. C. William Beebe on "A Naturalist's Camping Trip in Old Mexico."

Mr. Jonathan Dewight, Jr., on "Some of the Rare Birds of New York."

Prof. J. J. Stevenson on "A Visit to the Coal Fields of the Island of Spitzbergen."

Dr. George F. Kunz on "The Jagersfontein Diamond, the Largest Diamond ever Cut." Illustrated with models and photographs.

Dr. Edmund Otis Hovey on "St. Vincent, British West Indies. The Eruptions of 1902 and their Immediate Results." Illustrated.

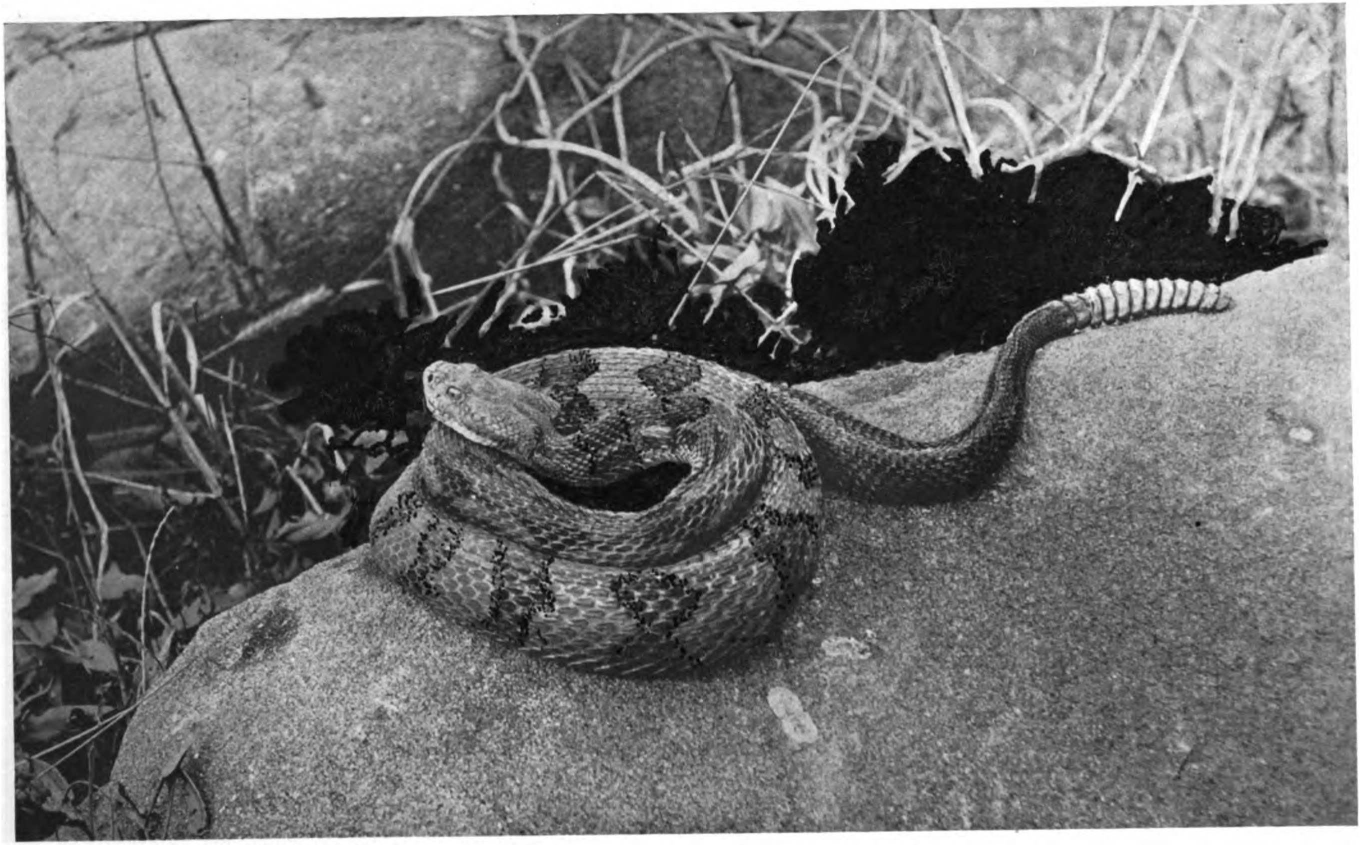


FIG. 1. BANDED RATTLESNAKE

The American Museum Journal

Vol. v. JULY, 1905. No. 3

THE principal article of the present number of the Journal is upon the snakes, lizards and turtles which are to be found in the vicinity of New York City. This article will be published separately as No. 19 of the Museum series of Guide Leaflets, and will form a convenient summary hand-book for use in the field as well as in connection with the collections on exhibition in the Museum. The author of the leaflet is Mr. Raymond L. Ditmars, Curator of Reptiles in the New York Zoölogical Park in Bronx Park, who is well known to all students of nature through his careful study and interesting descriptions of the forms of animal life which are his special study. The excellent photographs forming the basis of the illustrations were taken from living specimens by Mr. Herbert Lang, of the Museum.

CORALS OF THE HAWAIIAN ISLANDS.

During the past summer Dr. J. E. Duerden, Honorary Curator of Cœlenterates, carried out, under the auspices of the Carnegie Institution, an expedition to the Hawaiian Islands for the purpose of studying and collecting the living corals. The main object was to secure a representative series of Pacific corals from which comparison could be made with results already published upon West Indian forms. About three months were spent among the islands, the capital, Honolulu, being made the headquarters. The directors of the Rapid Transit Company there generously placed the facilities of their newly established aquarium at his disposal, the constant supply of fresh sea-water being of great assistance in keeping the corals alive for investigation day by day.

Between thirty and forty species of corals were collected,

besides numerous varieties of each species. These were studied in the living condition, and many specimens of each kind were preserved for later anatomical and histological investigation. More than fifty cases of dried corals, containing about 1,500 specimens, were obtained, forming probably the largest collection of Hawaiian corals ever made. These have been received at the Museum and will constitute an important series for studies on the variations of coral growth. A special feature of the collection is the large number of the mushroom coral, *Fungia*, showing all the stages of growth in both the fixed and free conditions.

While engaged in studying the specific characters of the corals, a series of experiments upon the physiology and reactions of the living polyps was carried out, a line of investigation upon which scarcely anything has hitherto been done. Important facts bearing upon the method of feeding of living corals were learned; particularly the part played by mucus, or slime. Particles of food placed on the disc of the polyps lead to an exudation of mucus, the opening of the oral aperture, and the establishment of an inhalent current by means of which the nutritive substances are ingested, after being imbedded in the mucus.

In addition to the collection of corals a representative series of Hawaiian actinians was also secured to supplement the "Albatross" collections made by the U. S. Bureau of Fisheries in 1902, upon a report of which Dr. Duerden is now engaged. Several specimens of crabs having the peculiar habit of carrying an actinian in each claw were also obtained, and observations and experiments made upon their habits and relationships. It is found to be a remarkable case of commensalism: the actinians serve to protect the crab, and in addition the crab actually makes use of the actinian in order to procure its prey, abstracting food from it. The crab in its turn has undergone certain structural modifications on account of the association.

THE Department of Invertebrate Palæontology has two parties in the field this season: one in charge of Mr. Walter Granger, searching for fossils in southwestern Wyoming, and the other under Mr. Barnum Brown exploring fields in Montana.

THE PUPILS' COURSE OF LECTURES.

THE second series of lectures to the public-school children, the programme of which was published in the April number of the JOURNAL, comprised thirty-four lectures upon twelve subjects. The records show that the total attendance at these lectures was more than 20,000 school children from Staten Island, Brooklyn and the upper Bronx, as well as from Manhattan. Although the usual number coming from each school was from forty to sixty pupils, some schools sent large delegations, notably P. S. 189, 99th St. and Second Ave., from which 200 to 400 pupils came to a lecture, and P. S. 177, Market and Monroe Sts., from which 200 to 300 pupils were brought. The lectures were not given during school hours, and attendance at them was in no wise compulsory, so that, inasmuch as the classes were accompanied by their teachers, the large numbers of pupils availing themselves of the opportunity to supplement their class work indicates not only the interest felt by the children in their studies, but also that of the teachers in their classes.

Although the lectures were primarily designed to supplement the classroom work, they undoubtedly have been the indirect cause of spreading much general information. Frequently teachers with their pupils have arrived early at the Museum and have spent an hour or more before the opening of the lecture in studying the collections, for instance: the bird groups and the series illustrating the protective coloration and mimicry of insects. On the way to the lecture hall children have caught glimpses of exhibits which have aroused their interest to such an extent that afterwards they have been seen at the Museum on Sundays or holidays accompanied by their parents.

THE Carnegie Institution has recently published a paper, "The Coral *Siderastræa radians* and its Postlarval Development," by Dr. J. E. Duerden, Honorary Curator of Cœlenterates. The work is based upon observations carried on for four months while the author was Curator of the Museum of the Institute of Jamaica, and was completed at the American Museum.

THE CIRCULATING NATURAL HISTORY LOAN COLLECTIONS.

OWING to the increase during the school year 1904–1905 in the demand for the small nature study collections which the Museum loans to the public schools it has been necessary to prepare additional sets. The following collections have been added to those in use last year: Owl, Blue Jay, Robin and Bluebird, ten each, duplicating the original bird collections, and ten collections, constituting a new series, each containing a Pigeon, a Goldfinch, a Hummingbird, a Vireo and a Scarlet Tanager. Twenty sets of a collection showing cross, longitudinal and oblique sections of ten species of our more common trees have also been prepared. The total number of collections available for nature study work at the present time is 235. They have been in use in 184 of the city schools, distributed among the Boroughs as follows: Manhattan, 139; Brooklyn, 28; Bronx, 13; Queens, 3; Richmond, 1.

Up to May 1, the collections have been studied by 255,845 pupils, as follows:

Birds	157,649
Insects	34,532
Woods	21,836
Minerals	12,185
Mollusks	9,452
Starfish	8,133
Corals	6,115
Crabs	5,943

The total number of pupils studying the different sets to the end of the school year will be about 325,000.

MUSEUM NEWS NOTES.

APPRECIATION of the work done by the Jesup North Pacific expedition in the study of the tribes of Eastern Siberia has been shown in special manner by the Czar of Russia, who has bestowed upon President Jesup the Knighthood of the Imperial and Royal Order of St. Stanislaus of the first degree. The or-

der of St. Stanislaus is one of the oldest and most distinguished of the Russian Empire.

Mr. Frank M. Chapman represented the Museum at the Fourth International Ornithological Congress which was in session at the Imperial Institute, South Kensington, London, and other places in England, June 12 to 21. In addition to making careful studies of Museum methods at the British Museum and elsewhere in the United Kingdom, Mr. Chapman will study several features of the bird life of the British Isles before he returns.

During May Professor W. M. Wheeler and Dr. B. E. Dahlgren made an expedition to New Mexico, Arizona and California, for the purpose of studying the vegetation and invertebrate fauna of the desert. Through the kindness of Dr. F. V. Coville and Dr. W. A. Cannon they were able to work for a week at the Carnegie Desert Botanical Laboratory at Tucson, Arizona. Collections of specimens (including some ten thousand Formicidæ) were made at the following localities: Las Vegas and Albuquerque, New Mexico; Ash Fork, Prescott, Phœnix, Tempe, Tucson and Yucca, Arizona, and the Needles, California. A few days were also spent in and about the Grand Cañon of the Colorado. Professor Wheeler was able to complete his study of the North American desert Formicidæ, a study begun some years ago in Trans-Pecos, Texas. The nesting habits of several interesting species were observed for the first time and valuable photographs of nest architecture, characteristic desert environment, etc., secured. He also succeeded in gathering much information concerning the geographical distribution of the species and their dependence on soil, vegetation, amount of moisture, etc. A very interesting zonal distribution of species was observed on the walls of the Grand Cañon.

Dr. Dahlgren secured plants, soil, etc., needed for the accessories for several animal groups (antelope, peccary, prairie-dog and rattlesnake) now in process of preparation in the Museum.

At the request of the principals and teachers of several public schools, the Museum offered a course last spring in nature study

along the lines of their school work. The course consisted of six exercises—three on birds and three on insects—and embraced both laboratory and lecture work. The class met on Tuesday afternoons at four o'clock, during April and May, 35 being the average attendance. Owing to the absence on expeditions of Mr. Chapman and Professor Wheeler, arrangements were made with Mr. Jules M. Johnson, of the Morris High School, to conduct the course.

THE Department of Anthropology is participating in several expeditions in the Far West. Dr. P. E. Goddard, Instructor in Anthropology in the University of California, has gone among the Sarcee Indians of Canada. These Indians have been the means of the transmission of culture from the Plains Indians to the Athapascans of the woodlands and possess a mixed civilization. The object of the expedition is to secure facts regarding a definite case of mixed cultures and to collect specimens which, taken in relation to the collections from related types now in the Museum, will illustrate the extent and nature of such mixture. Mr. Frank G. Speck will visit Indian Territory and make ethnological collections. Mr. Edward Sapir is doing linguistic work among the Chinook of the Columbia River Valley and investigating the basketry decorations of the neighboring tribes. Dr. William Jones, Research Assistant in the Carnegie Institution of Washington, will visit the Algonquin Indians of the Great Lake region to continue his investigation of religious beliefs and practices. He will also strive to complete the collections in this Museum from that region. Miss Constance Goddard Du Bois will continue her studies of the music and mythology of the Indians of Southern California and make a special collection of basketry.

THE specimens of rocks and ores, nearly 400 in number, which were collected by Dr. E. O. Hovey on his recent expedition into the Sierra Madre region of western Chihuahua, Mexico, have been received at the Museum and catalogued. These and the 400 excellent photographs obtained of the wonderful country traversed are now open to the inspection of those interested in the region.

THE REPTILES OF THE VICINITY OF NEW YORK CITY.[1]

By Raymond L. Ditmars,

Curator of Reptiles, New York Zoölogical Park.

Introduction.

In compiling this guide for the identification of the local reptiles, the writer has endeavored to present the subject in a simple and concise manner, avoiding technicalities as far as possible. The usual descriptions of reptiles concern arrangements of the scales upon the head and certain other physical characteristics that are necessarily associated with technical terms, but the keys for identifications and descriptions of the species in the present work appeal principally to the *coloration* and *form* of the reptiles. With but a limited number of species to consider, this plan seems appropriate, since it greatly simplifies the subject.

The reptiles described are those which have been found within a radius of about fifty miles of New York City. Within this section 28 species are represented. Of these species 14 are serpents, 2 are lizards and 12 are turtles. Thus our local fauna may be said to be quite rich in reptile life. In fact, it is within the limits of the area described that certain species of snakes (the Garter Snake, *Thamnophis sirtalis*, and the Brown Snake, *Storeria dekayi*) abound to such an extent that hundreds of specimens are annually killed and captured without apparent decrease in their numbers.

There are but two local species of poisonous snakes, the Banded Rattlesnake and the Copperhead. In certain districts both are fairly abundant, but may be hardly called a menace to mankind, as one is shy and retiring in habits, while the other

[1] Issued also in separate form as **Guide Leaflet** No. 19.

evinces an unmistakable characteristic of warning. There are but few records of the bites of venomous snakes in this portion of the United States.

SNAKES.

Order *Ophidia*.

The snakes are well represented in the Atlantic states, fourteen species being distributed through sections of the region surrounding New York City. Some of these reptiles attain fair dimensions, and several of the species are brilliantly colored. Two are venomous and of sufficient size to be formidable to man. These dangerous snakes, the Rattlesnake and the Copperhead Snake, may be recognized by their triangular heads which are quite distinct from the neck. The blunt tail of the Rattlesnake, terminating in its warning appendage, is a character hardly possible to be overlooked by the most indifferent observer. The Copperhead Snake is so strongly marked that identification is but the question of a moment's intelligent examination after an idea of the color pattern has been acquired.

Several of our harmless snakes have been provided with eccentric and misleading titles. To those unacquainted with reptiles, such species as the "Flat-headed Adder," the "Spotted Adder," the "Water Moccasin" and others of equally formidable appellation might be regarded as reptiles not entirely devoid of harm. Many of our harmless snakes which are of substantial economic importance in the destruction of the smaller injurious mammals possess the most evil reputation, although they really aid the agriculturist. The slaughter of these useful reptiles by the misinformed is a genuine calamity.

In the key to the identification of the local snakes, the attention of the student is especially directed to *color* and the *formation of scales*. Snakes are either provided with *smooth* or *keeled* scales, the latter having a distinct ridge, or keel, running lengthwise. The Garter Snake and the Water Snake are examples of snakes possessing *keeled* scales. This simple plan makes identification easy, and excludes the usual technical reference to the complicated arrangement of the scales or shields of the head, which requires technical knowledge for satisfactory

comprehension. To aid in this idea, the species are grouped in the key without regard to technical classification.

Key to the Identification of the Local Snakes.[1]

a. SCALES SMOOTH.

Size small.

Light brown above; pinkish beneath; snout conical .... **Worm Snake** (*Carphophis amœnus*).

Pale green above; white beneath .... **Green Snake** (*Cyclophis vernalis*).

Dark gray above; a yellow ring around the neck; yellow beneath .. **Ring-necked Snake** (*Diodophis punctatus*).

Size moderate.

Gray, with chestnut saddles above; beneath white, with square spots of black .... **Milk Snake** (*Lampropeltis doliatus triangulus*).

Size large.

Uniform satiny black above; black beneath, with the chin and throat white .... **Black Snake** (*Bascanion constrictor*).

aa. SCALES OF THE BACK FEEBLY KEELED.

Size large.

Black above; beneath white, blotched with gray; scales of the sides show white edges .... **Pilot Blacksnake** (*Coluber obsoletus*).

b. SCALES KEELED.

Size small.

Brown above; pink beneath .... **DeKay's Snake** (*Storeria dekayi*).

Brown or gray above; bright red beneath .... **Storer's Snake** (*S. occipito-maculata*).

Dark brown or black above, with a yellow stripe down the back and a similar stripe on each side on third and fourth rows of scales from underside .... **Ribbon Snake** (*Thamnophis saurita*).

[1] All of the local harmless snakes have eyes with round pupils. The two species of local poisonous snakes have elliptical (cat-like) pupils.

Size moderate.

Dark brown or black above, with a yellowish stripe down the back and a light stripe on each side on second and third rows of scales from underside............................**Garter Snake** (*Thamnophis sirtalis*).

Dark brown or gray above, with reddish transverse bands; white or yellow beneath spotted with red...**Water Snake** (*Natrix fasciata sipedon*).

Dark yellow or brown, with darker transverse markings; snout upturned and sharp................**Hog-nosed Snake** (*Heterodon platyrhinus*).

Head triangular, distinct from neck.

Light chestnut brown or pinkish-gray, with a series of dark brown transverse bands, narrow on the back and becoming wide on the sides............................**Copperhead Snake** (*Ancistrodon contortrix*).

Yellow, with dark transverse bands; sometimes dark tan or uniform black; tail ending in a rattle.....**Banded Rattlesnake** (*Crotalus horridus*)

FIG. 2. HEAD OF DIAMOND-BACKED RATTLESNAKE. SOUTHERN STATES

Descriptive List of the Snakes.

HARMLESS SPECIES.

FIG. 3. WORM SNAKE

The Worm Snake, *Carphophis amœnus* (Fig. 3), is a diminutive species which, though fairly abundant, is seldom seen, owing to its secretive habits. The Worm Snake is quite characteristic in appearance with its smooth, shining, cylindrical body and sharp snout; the head and neck are of the same width. In color this little serpent is quite somber and in harmony with the surroundings in which it lives. Above, it is light brown or brownish gray; beneath, the color is a delicate shade of pink. In length, the species seldom exceeds eleven inches.

Worm Snake.

This reptile might possibly be confounded with the Storer's Snake and the DeKay's Snake, which small, retiring species it in a way resembles, principally in color and size, but it may be immediately recognized by its smooth scales; both of the other

species having keeled scales. The Worm Snake frequents damp localities and soft, loose ground, where it burrows with the aid of its sharp snout. Specimens are sometimes found in decaying logs. It is seldom found wandering about above the surface, except among damp leaves or after showers. The food consists largely of earthworms and soft grubs. This snake is oviparous.

Range: Central and eastern United States.

Local distribution: Long Island; Palisades of the Hudson.

FIG. 4. MILK SNAKE

The Milk Snake, *Lampropeltis doliatus triangulus* (Figs. 4 and 5), is one of the most brightly colored of the local snakes.

Milk Snake.

The body above is yellowish brown or gray, with a series of irregular chestnut-brown or reddish spots edged with black, about fifty in number; on the sides are smaller spots in alternation with those of the back. Beneath, the reptile is white, with numerous, small oblong spots of black. The length, when mature, is from three to four feet. The scales are smooth and polished.

Although this species is generally distributed, it is not of common occurrence. From a habit of sometimes frequenting the neighborhood of stables and dairies, it has acquired the reputation of obtaining milk from the cows. This is an illogical

FIG. 5. MILK SNAKE; WITH EGGS

theory, and proof of the actual deed from reputable observers is wanting. In captivity this serpent is wholly indifferent to milk, but will eat mice, young birds and small snakes other than its own species. It is a constrictor and closely related to the King Snake of the southern states. The Milk Snake is oviparous, laying eggs to the number of two dozen or more.

Range: The central and eastern United States; Canada.

Local distribution: General; frequents woods.

Ring-Necked Snake.

The Ring-Necked Snake, *Diadophis punctatus* (Fig. 6), is the most easily distinguished of the various local snakes. The scales of this little reptile are smooth and shining, while the body is a uniform dark gray or bluish black, with a brilliant yellow ring around the neck immediately behind the head. Beneath, the color is orange yellow; a single row of black spots is generally present. The length seldom exceeds fifteen inches.

These little snakes may be occasionally found in damp woods, under stones or burrowing under the bark of decaying trees. The species is quite rare within the limits under

consideration, but in some portions of the Hudson Highlands and in the Catskill Mountains it is rather abundant. In the southern states it is very common, the writer having taken several hundred specimens within a few days' time by stripping the bark from old, fallen trees. The Ring-necked Snake feeds largely upon earthworms and the smaller species of salamanders. It is oviparous.

Range: The United States east of the Rocky Mountains; Canada.

FIG. 6. RING-NECKED SNAKE

Local distribution: General.

Dainty and inoffensive both in looks and habits, the little Green Snake, *Cyclophis vernalis* (Fig. 7), may be easily known by its color which makes it quite distinct from other local species. The color above is a uniform pale green and beneath is light yellow or white. The scales are smooth and possess a satiny luster.

Green Snake.

The Green Snake differs from the majority of serpents in being insectivorous. It feeds largely upon hairless caterpillars, although it also consumes crickets, grasshoppers and spiders. The usual length of the animal is about two feet. This species is oviparous.

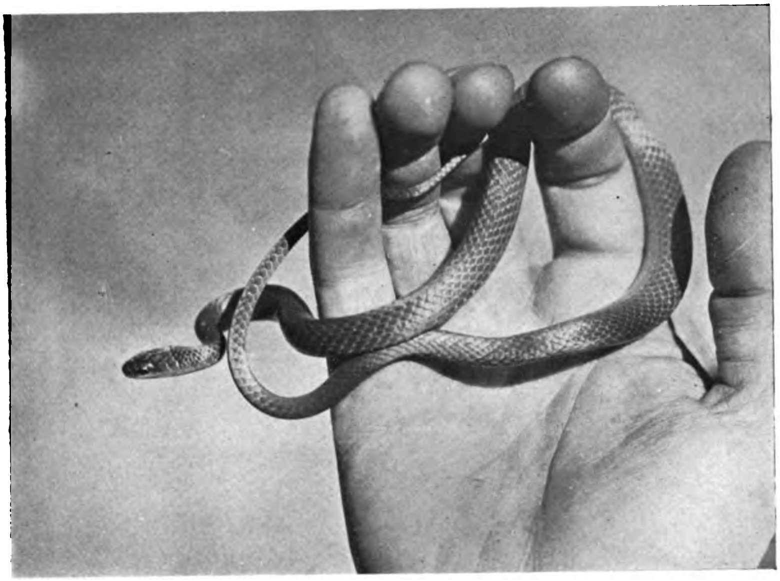


FIG. 7. GREEN SNAKE

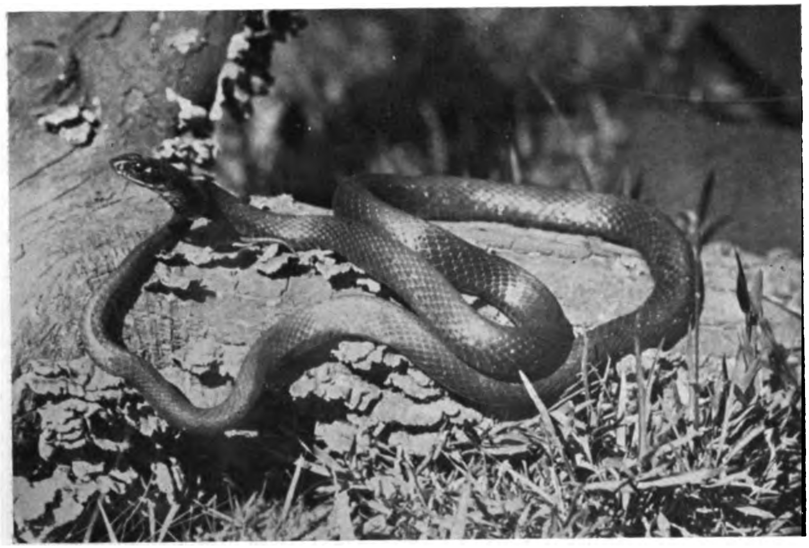


FIG. 8. BLACK SNAKE

Range: The United States east of the Rocky Mountains; Canada.

Local distribution: Common in Rockland, Dutchess and adjoining counties.

With the exception of one other species, the Black Snake, *Bascanion constrictor* (Fig. 8), attains the largest dimensions of any of the local serpents. Above and beneath, with the exception of the chin and throat, this reptile is a uniform black, the smooth scales imparting to the creature's back a luster similar to that of a gun-barrel. The chin and throat are milky white.

Black Snake.

Young specimens show a remarkable variation from the adult snake. Like all the snakes described thus far, the Black Snake is an egg-laying species (oviparous). As is the case with the majority of the oviparous snakes, the eggs are left by the parent to be hatched by the heat of the sun or of decomposing vegetation. At the time of hatching, the young Black Snake belies its name. The body is pale gray with a series of brownish blotches down the back; the head and sides are irregularly spotted with black. At this stage it closely resembles the Milk Snake, but may be distinguished therefrom by the tendency of the blotches on the back to become very narrow as they approach the tail and to disappear almost altogether on that appendage. When a year old, the body color has become very dark, but close inspection will reveal the dorsal blotches. As age progresses the body color becomes darker until it assumes the intense black of the adult.

Extremely agile and feeding upon small rodents, birds, frogs and other snakes, the Black Snake is not a constrictor as its technical name implies, nor is it nearly so courageous as is generally supposed. When surprised, this reptile will invariably take to flight if this be possible, and few serpents can show the speed of this black meteor as it darts away, to stop only when apparent safety is attained. When cornered and escape is cut off, this snake will fight bravely, but the slightest opening is instantly taken advantage of by a dash for cover. The needle-like teeth can produce nothing but the most superficial wounds, yet this serpent is quite generally dreaded. Without doubt the

Black Snake is of value in the woods and fields, since its appetite craves the smaller mammals which are a menace to the agriculturist. The average length of adult specimens is between five and six feet.

Range: The entire United States and southern portions of Canada.[1]

Local distribution: General, in rocky localities.

FIG. 9. PILOT BLACKSNAKE

Pilot Blacksnake.

The Pilot Blacksnake; Mountain Blacksnake, *Coluber obsoletus* (Fig. 9), attains the greatest length of any of the snakes embraced in the present list. This species is a powerful constrictor, and is the northern representative of the large and brilliantly-colored Rat Snakes of the South.

To the novice this serpent might appear similar to the preceding species. This similarity, however, applies only to color. Unlike the Black Snake or Racer, the scales are polished and the body presents a metallic, shining appearance instead of a satiny luster.

[1] The typical (black) form inhabits the Eastern States; a variety of lighter color frequents the Middle States; in the Western States is the variety called the Green Racer (*B. constrictor flaviventris*).

The general color above is black, the scales of the sides showing white edges when the body is distended. Beneath, the color is white, blotched with gray on the forward portion; posteriorly the gray becomes suffused over the entire surface; the chin and throat are white and immaculate. Close examination will reveal the scales of the back to be faintly keeled, which characteristic at once separates the species from the Black Snake. The head is broad and rather flat; the under surface of the body is so abruptly flattened as to form right angles with the sides.

This species is built rather for climbing than for speed, and generally frequents low bushes, where it lies in wait for birds and small mammals. The species attains a length of more than six feet. It is oviparous.

Range: Eastern United States from Maine to Florida; the Central States; in the South the species extends westward to Texas.

Local distribution: Highlands of the Hudson; not common.

Hog-nosed Snake.

The Hog-nosed Snake, *Heterodon platyrhinus* (Figs. 10 and 11), may be recognized by its sharp, upturned snout, which shovel-like appendage is employed to assist the reptile in burrowing in the sandy soil in which it lives. The markings of this peculiar snake are extremely variable, but the color is generally yellowish brown, with dark brown or black irregular cross-bands. Some specimens show brilliant shades of yellow and red; others are entirely black. The latter constitute the variety *niger*.

The species is stout in body, and the scales are keeled. When annoyed, it assumes a threatening attitude by flattening the head and neck and hissing loudly. In spite of its hostile demeanor, it seldom attempts to bite, but contents itself by endeavoring to frighten the object of its annoyance by its eccentric antics. In different localities the species has been given appellations that have placed this harmless reptile in bad repute. Such names as "Flat-headed Adder," "Blowing Viper" and "Spreading Adder" are energetically used by the farmer who usually refuses to be convinced that this snake is not akin in poisonous faculties to the Copperhead, to which it bears some resemblance in proportions and markings.

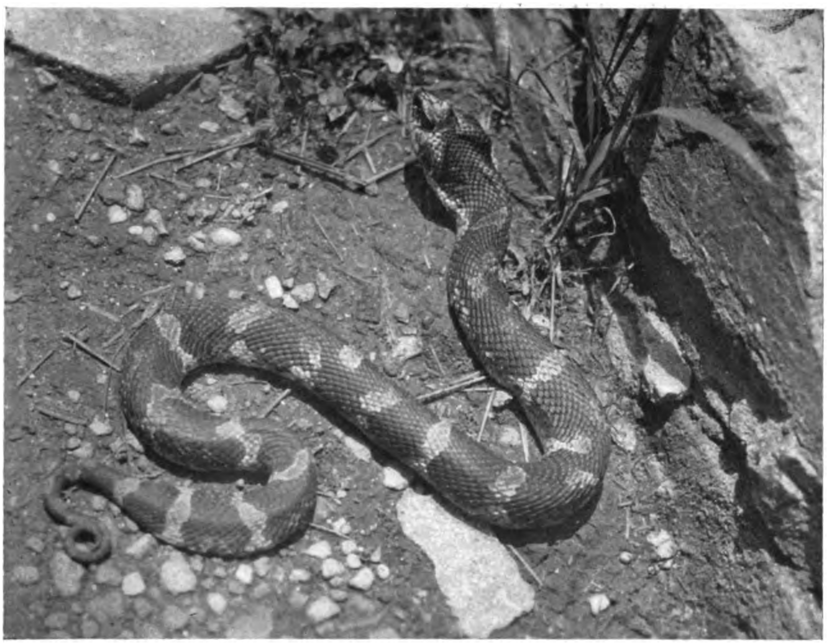


FIG. 10. HOG-NOSED SNAKE

FIG. 11. HOG-NOSED SNAKE (VAR. NIGER)

When repeatedly annoyed, this snake will feign death and may then be roughly handled without its displaying signs of life. Its food consists principally of toads. The species is oviparous, depositing about two dozen eggs. A large specimen will measure three feet in length and one and a half inches in diameter.

Range: The United States east of the Rocky Mountains.

Local distribution: Found in nearly all the sandy localities adjacent to New York City. Common on Long Island and the Bayonne peninsula, New Jersey.

FIG. 12. RIBBON SNAKE

Ribbon Snake.

The Ribbon Snake, *Thamnophis saurita* (Fig. 12), is a species which might be easily confounded with the Garter Snake, owing to the similarity of markings. The body color is dark brown or black, with a bright and very clearly-defined stripe of yellow down the back and a similar stripe on each side. The body is very slender and the scales are distinctly keeled. When the skin is distended the sides of the body show small, white spots.

The chief differences between this species and the Garter

Snake are the following: 1. The stripes on the sides are situated on the third and fourth rows of scales from the plates of the crawling surface; with the Garter Snake the lateral stripe is situated on the second and third rows of scales. 2. The underside is immaculate, while the abdomen of the Garter Snake shows a row of small black spots on each side. 3. The Ribbon Snake is, in proportion, considerably more slender than the other species.

The active little Ribbon Snake frequents damp meadows and woods. It seldom exceeds three feet in length. Its food consists

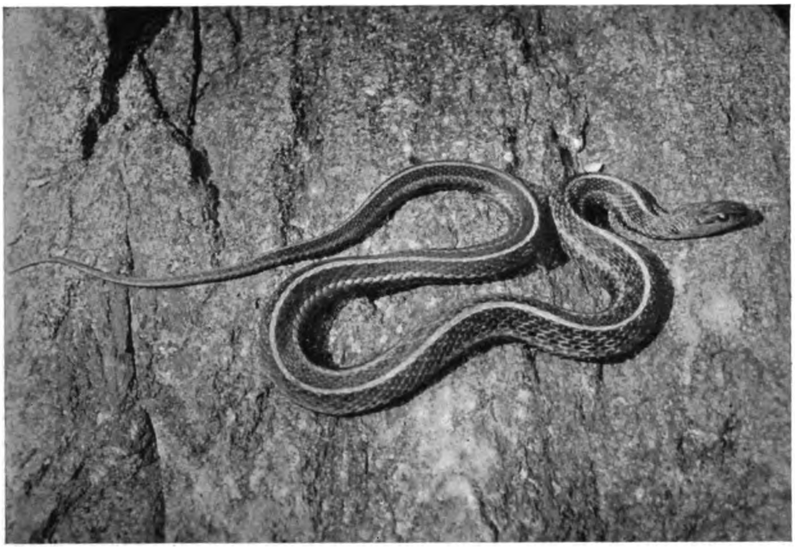


FIG. 13. GARTER SNAKE

of small fishes, tadpoles and frogs. The species is viviparous, but the number of young is small, seldom amounting to a dozen.

Range: Southeastern Canada and the United States east of the Rocky Mountains.

Local distribution: General, but not common.

Garter Snake.

The Garter Snake, *Thamnophis sirtalis* (Fig. 13), is the most common of our local serpents. The general color above is dark-brown or black, with three yellowish stripes running lengthwise; beneath, the color is greenish yellow. The skin along the sides when distended shows numerous white

or greenish spots. The scales are strongly keeled. The species varies in color; specimens are occasionally found upon which the stripe on the back is indistinct or entirely wanting; others present a spotted appearance between the stripes.

Abundant under various conditions of swamp, woods and rocky localities, the Garter Snake will continue to exist within our local borders long after many of the other species of serpents have been exterminated by the ruthless slaughter that unjust prejudice inspires. The species is viviparous, bringing forth as many as thirty or more living young at a brood. The young reptiles feed upon earthworms and grow rapidly. While immature, these snakes are secretive, and the character of their food enables them to obtain a livelihood without prowling forth into danger. Far different is the case of the active young Blacksnake in seach of mice, as it crosses roads and clearings into the danger zone of stones and clubs.

The adult Garter Snake feeds mostly upon frogs and toads; birds and small mammals are never devoured by this species. The length of a large specimen is about a yard.

Range: North America, southward to Guatemala.

Local distribution: General and common; is found in the large parks of New York City.

Water Snake.

Our common Water Snake, *Natrix fasciata sipedon* (Fig. 14), is a variety of a species abundant in the southern states. The body is rather stout, with strongly keeled scales; the color is brown with broad irregular cross-bands of reddish brown which show more distinctly on the sides. The underside is yellowish white, brightly marked with red spots and blotches. The young of this species are quite different from the adult in coloration, the body color being gray with the cross-bands black and very distinct. The adult attains a length of four feet and a diameter of two inches. From two and a half to three feet long, however, is the usual size.

Always frequenting the vicinity of water, this snake may be seen in numbers along slow-running streams, either sunning itself on the banks or stretched upon the branches of bushes that overhang the water. It feeds upon fishes, frogs and toads. The Water Snake is viviparous, bringing forth as many as forty

or more young at a litter. The young are born during the latter part of August and early in September.

Range: The eastern United States from Maine to North Carolina.

Local distribution: Common near ponds, streams and salt-water marshes.

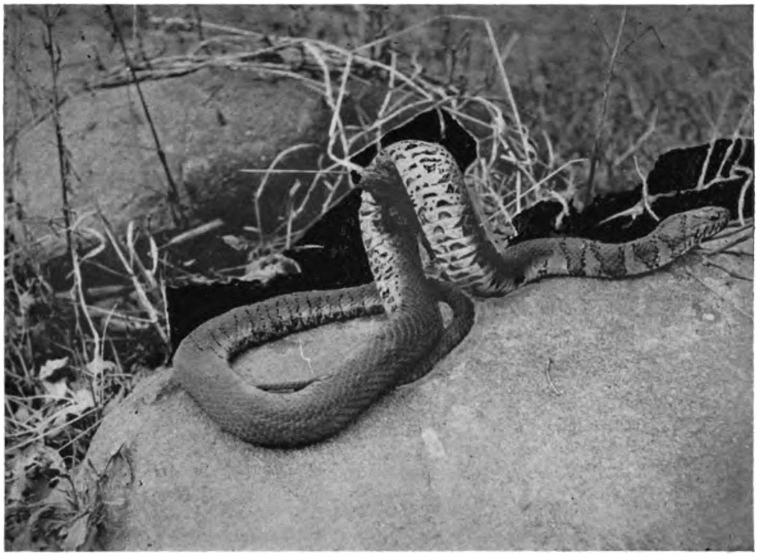


FIG. 14. WATER SNAKE

Brown Snake.

Among the local snakes, DeKay's Snake, or Brown Snake, *Storeria dekayi* (Fig. 15), is unique in surviving in localities where the other serpents have long since been exterminated. It is common in many portions of the large city parks, where its secretive habits, diminutive size and quiet colors aid in its protection.

In color this reptile is brown or brownish gray above, with a minute series of black spots in pairs usually present down the back; the space between these spots is sometimes of a lighter tint than the body color, producing the appearance of an indistinct stripe in some specimens; beneath, the color is pinkish white. The scales are keeled. The average length of adult specimens is twelve inches.

This snake is most frequently found hiding under flat stones, and in such places the reptile searches for its favorite food, which consists of earthworms.

The Brown Snake is viviparous, producing from fifteen to eighteen young during August. During the first year the young snakes are very dark with a whitish ring around the neck. At this stage they resemble the young of the Ring-Necked Snake,

FIG. 15. DEKAY'S, OR BROWN SNAKE

but they may be distinguished therefrom by their keeled scales. When adult, the average length of the Brown Snake is about fourteen inches.

Range: Canada and the eastern United States from the Atlantic coast westward to Kansas and southward to Mexico.

Local distribution: Common in rocky localities.

Red-Bellied Snake.

The Storer's Snake, or Red-Bellied Snake, *Storeria occipito-maculata* (Fig. 16), closely resembles the Brown Snake, but may be distinguished therefrom by its bright vermilion underside. Down the back of Storer's Snake there is usually a well-defined stripe of a lighter shade than the body color, which is brown or dark gray; occasionally specimens are slaty gray with a light stripe down the back bordered with rows of minute black spots. On such specimens the bright red of the underside is especially intense. It is a smaller species

than the preceding, seldom attaining a length of more than eleven inches. The young are produced alive, and are black with a whitish ring around the neck.

Range: The same as the preceding species, but may extend farther north in Canada.

FIG. 16. STORER'S, OR RED-BELLIED SNAKE

Local distribution: Not found within the immediate vicinity of New York City, but is common northward; occurs abundantly in Orange, Rockland and Putnam Counties.

POISONOUS SPECIES.

Copperhead Snake.

The Copperhead Snake, *Ancistrodon contortrix* (Fig. 17), is a strongly marked species and easily determined. The body color is light chestnut brown, sometimes assuming a tinge of pink, crossed with dark, reddish-brown bands, which are narrow on the back and wide on the sides, resembling from above the outlines of a dumb-bell; these bands are darkest at their edges, particularly on the sides of the body. The head is somewhat lighter than the body, usually exhibiting a coppery tinge or a bright hazel brown; the sides of the head are of a still

paler hue. The line of intersection of the lighter color with the coppery tints of the top begins behind the eye and runs to the angle of the mouth. Beneath, the body is pinkish white, with two rows of reddish-brown blotches; the scales are keeled; the pupil of the eye is elliptical.[1]

Although the head of this serpent is triangular and distinct from the neck, the general appearance of the reptile would not immediately lead the uninitiated to class it as a poisonous snake. Several of our local serpents are quite as heavy in body as the

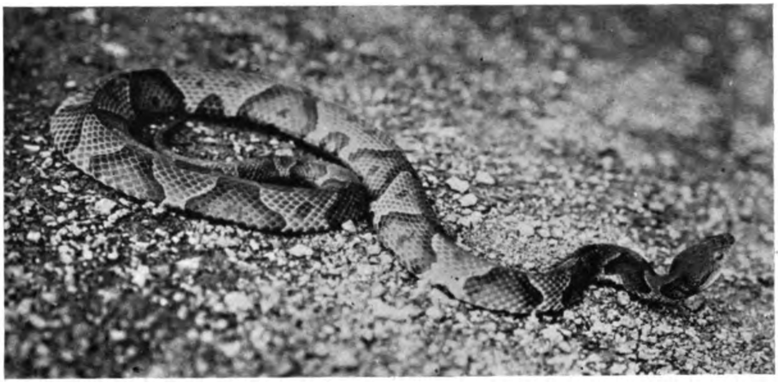


FIG. 17. COPPERHEAD SNAKE

formidable Copperhead. The Milk Snake, the Hog-nosed Snake and the Water Snake are sometimes confounded with the Copperhead, partly on account of a similarity of pattern, and partly on account of the stout bodies of the last two species. From the Milk Snake the Copperhead may be at once distinguished by its keeled scales; from the Hog-nosed Snake and the Water Snake by the arrangement of the plates under the tail.[2] Beginning from the vent, these broad plates in the harmless reptiles are in two rows; in the Copperhead they are arranged in one row, extending across the underside of the tail like the plates of the belly, with the exception (in some specimens) of a few scattered, divided plates near the tip of the tail. From all the harmless snakes the Copperhead may be distinguished by the presence of a

[1] The eyes of all of our harmless snakes have round pupils.

[2] The sub-caudal plates of all the harmless snakes are in two rows.

pit between the eye and the nostril, a characteristic of the crotaline snakes that has led to their popular title, "the Pit Vipers."

The upper jaw of the Copperhead is provided with two long fangs which fold against the roof of the mouth when the latter is closed. These teeth are hollow and are provided with an opening at the tip for the ejection of poison. They are precisely the same in their formation as the needle of a hypodermic syringe. The poison is secreted in glands behind the reptile's eyes, and is forced through the fangs by muscular contraction during the act of biting.

The Copperhead is the most beautiful of our local snakes, its delicate colors so closely resembling the falling leaves of autumn that it is with difficulty to be distinguished from its surroundings at that time of the year. When annoyed, it imparts a rapid, vibratory movement to the tail, which when among dried leaves produces a distinct rattling, audible for several feet. Its bite is very dangerous, but the snake is not habitually hostile and it prefers flight to combat. When cornered, however, it will fight bravely, striking from a partly coiled position. The food of this snake consists of small mammals, birds and frogs. From six to nine young are produced alive during August or early in September. The tails of the young snakes are bright sulphur-yellow, which tint gradually fades as the reptile matures. A large adult specimen will measure three feet in length.

Range: Massachusetts to Florida, westward to Texas.

Local distribution: Palisades of the Hudson River, northern Westchester, Rockland, Putnam and Orange Counties, N. Y. Prefers thick, damp woods and in some districts (Orange and Rockland Counties) is moderately abundant.

Banded Rattlesnake.

With the rattle as an unvarying characteristic, the dangerous Banded Rattlesnake, *Crotalus horridus* (Figs. 1 and 18), may be instantly recognized. Female specimens are generally sulphur-yellow or brown, with black, or dark-brown transverse bands; the males are usually very dark brown or black with little trace of the bands, except yellow markings that show the location of the borders of the transverse blotches. The scales are roughly keeled. The head is triangular and covered with small, irregular scales.

The young are produced during the latter part of August to the number of about a dozen. They grow rapidly and acquire, on an average, three joints of the rattle every year; the young snakes are born with a single "button" on the tail. The average length of a mature snake of this species is from three and a half to four feet.

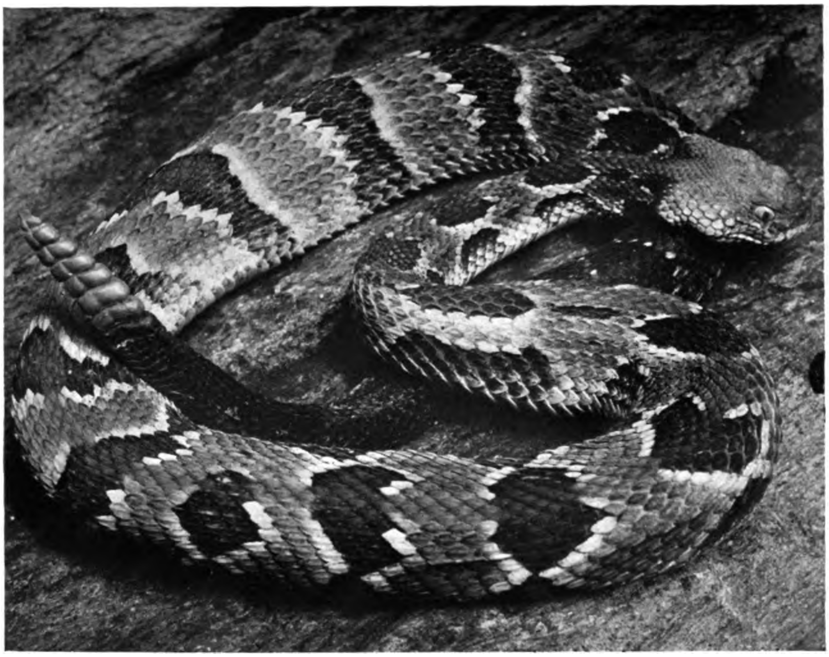


FIG. 18. BANDED RATTLESNAKE

Subsisting upon larger prey, such as squirrels, rats, young rabbits and birds, the Rattlesnake is a bolder reptile than the Copperhead. Provided with proportionately longer fangs and a more virulent poison, the bite of this species is more dangerous than the former. It generally frequents rocky localities and has a wide range of distribution.

Range: Massachusetts to northern Florida, and westward to Texas.

Local distribution: Within fifty miles of New York City, the Rattlesnake is now very scarce. Occasional specimens are reported from Putnam County.

LIZARDS.

Order *Lacertilia.*

The local Lizards, which number two species, are so different in general aspect that immediate identification is possible even to the novice. The smooth, shining Blue-tailed Lizard and the rough, somber-tinted Fence Swift are the examples. The occurrence of the latter species is rare within the limits embraced by this list. Both species are very active, and are insectivorous in habits.

Key to the Identification of the Local Lizards.

a. BODY SMOOTH AND SHINING:
Two phases—
aa. Body black, with five yellow stripes; tail blue.............*Young.*
ab. Body brown; stripes indistinct or wanting; head reddish........*Mature.*
aa and *ab*....................**Blue-tailed Lizard** (*Eumeces quinquelineatus*).

b. BODY ROUGH; THE SCALES KEELED:
Gray or brown with lighter blotches.. **Fence Swift** (*Sceloporus undulatus*).

DESCRIPTIVE LIST OF THE LIZARDS.

Blue-tailed Lizard.

The Blue-tailed Lizard, *Eumeces quinquelineatus* (Fig. 19), is an active species, generally distributed. It may be readily recognized by its smooth, shining scales and bright colors. There are two phases of coloring, one representing young individuals and the other the fully matured animals. Young specimens are black, with five bright

yellow stripes running lengthwise on the body; the tail of such specimens is usually a brilliant blue,—hence the name. Upon approaching maturity the body assumes a brownish tinge, the stripes become less distinct, and upon the males disappear altogether, while the head takes on a tinge of red. The females retain the stripes, although they are less distinct against the brown body-color than in young specimens; the head of the female is much narrower than the male, while the red tinge upon the same is never so brilliant as in the other sex. The complete color transformation takes about four years.

FIG. 19. BLUE-TAILED LIZARD, YOUNG AND ADULT

The female of this species deposits her eggs, to the number of about a dozen, under the bark of a decaying tree, and coils about the edge of the cluster in serpentine fashion until they hatch. Large specimens of the red-headed form measure eight inches in length. In the South the species grows much larger and is very abundant. The adult males are called "Scorpions."

Range: Southern Massachusetts to Florida; westward to Texas.

Local distribution: General in sunny openings of woods, but not common.

The Fence Swift, *Sceloporus undulatus* (Fig. 20), common everywhere in the southern United States, is very rare within a radius of fifty miles of New York City. In the pine forests of southern New Jersey this agile creature is particularly abundant, and may be seen darting with bewildering speed along fences and fallen trees.

Fence Swift.

FIG. 20. FENCE SWIFT

Unlike the Blue-tailed Lizard, so conspicuous on account of its shining scales, the Fence Swift presents a rough, lusterless surface. The scales are keeled and terminate in sharp, spine-like fashion. The body is rather broad, the head wide. In color this lizard is gray or brown with a series of V-shaped blotches on each side of the body; the underside is dark-gray or black with several large patches of blue. The latter patches vary in intensity according to conditions of temperature and the

activity of the reptile. Six inches is the average length of fully mature specimens.

Range: New Jersey to Florida.

Local distribution: Recorded from the Palisades of the Hudson River and Monmouth County, N. J.

TURTLES.

Order *Chelonia*.

Of the twelve species of turtles, or chelonians, found locally, three are marine wanderers from warmer climes and of rare occurrence. The marine turtles may be immediately recognized by their peculiar paddle-like limbs which are frequently termed "flippers." The use of these members in the progress of a sea turtle through the water has been appropriately compared to the flight of a hawk or an eagle. Of the other species of chelonians, one is strictly terrestrial in habits, while eight species are semi-aquatic and frequent the neighborhood of ponds and marshes.

The upper shell of a turtle is technically known as the "carapace," the lower shell as the "plastron." These terms have been employed throughout the description of the species with a view of abbreviation.

Key to the Local Turtles.

a. LIMBS LONG AND PADDLE-LIKE (FLIPPERS) .... **SEA TURTLES.**

aa. Carapace with seven heavy keels, running lengthwise.

Uniform dark brown....... **Leather-back Turtle** (*Dermochelys coriacea*).

ab. Carapace smooth.

Olive-brown; head very large; usually two nails on each flipper............. **Loggerhead Turtle** (*Thalassochelys caretta*).

Olive or brown, marbled with yellow; head of moderate size; usually one nail on each flipper............. **Green Turtle** (*Chelonia mydas*).

b. LIMBS AND FEET WELL DEVELOPED; FEET WEBBED.......................... **POND AND MARSH TURTLES.**

ba. Carapace smooth.

1. Plastron hinged to close against the carapace.

Dark brown; a yellow stripe on each side of the head.... **Musk Turtle** (*Aromochelys odoratus*).

Dark brown; head speckled. **Mud Turtle** (*Kinosternon pennsylvanicum*).

2. Plastron rigid.

Black or olive above; lower edge of carapace brightly marked with red; plastron yellow.................. **Painted Turtle** (*Chrysemys picta*).

Carapace black with numerous yellow spots; plastron black, blotched with yellow.................... **Spotted Turtle** (*Chelopus guttatus*).

Carapace black or brown, the shields showing lighter borders; head black; a brilliant yellow patch on each side behind the eye.. **Muhlenberg's Turtle** (*Chelopus muhlenbergii*).

bb. Carapace showing raised, angular lobes.

Plates of carapace concentrically ringed; light brown above, limbs, neck and fleshy parts salmon red... **Wood Turtle** (*Chelopus insculptus*).

Plates of carapace with numerous concentric rings; color, olive above, head

and limbs gray, profusely spotted with black....... **Diamond-Back Terrapin** (*Malacoclemmys palustris*).

Tail long, partly covered with plates; head very large; color brown or olive.................. **Snapping Turtle** (*Chelydra serpentina*).

c. FEET CLUB-SHAPED, NOT WEBBED........ **TORTOISES.**

Carapace high; plastron hinged; color brown, irregularly marked with yellow.................... **Box Tortoise** (*Cistudo carolina*).

FIG. 21. HEAD OF LEATHER-BACK TURTLE

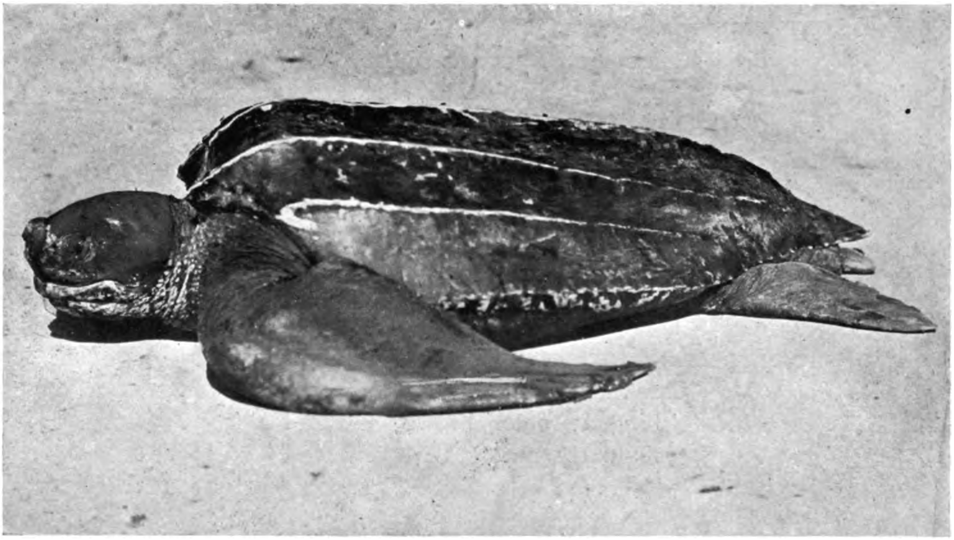


FIG. 22. LEATHER-BACK TURTLE

FIG. 23. LEATHER-BACK TURTLE; ON ITS BACK

Descriptive List of the Turtles.

Leather-back Turtle.

The Leather-back Turtle, or Trunk Turtle, *Dermochelys coriacea* (Figs. 21, 22 and 23), is easily distinguished from the two other species of sea turtles occasionally taken off our coasts, by the heavy, ridge-like processes, seven in number, running lengthwise on the carapace. Instead of the horny plates usually present on turtles, the carapace and plastron of this species are covered with a leathery integument. The Leather-back Turtle attains a large size. In warmer waters specimens are occasionally captured which exceed seven feet in length. The general color is dark brown, although there is sometimes a sprinkling of yellow. Like the other sea turtles this species never comes to the shore, except for the purpose of depositing eggs. Its flesh is of no value for food purposes. The reptile feeds upon fishes, crustacea, mollusks and seaweeds.

Range: Tropical seas.

Local distribution: Occasionally off the Atlantic coast of the Middle Atlantic and New England States, where its presence is accidental.

Loggerhead Turtle.

The Loggerhead Turtle, *Thalassochelys caretta* (Figs. 24 and 25), might possibly be confounded with the Green Turtle, owing to a similarity of the shells of these species. Certain characters, however, make determination comparatively simple. The head of the Loggerhead is very large in proportion to the reptile's size; the flippers are generally provided with two nails, while the shell is dark brown, sometimes marked with a lighter brown. The colors of the Green Turtle are much lighter; the head of medium size; there is generally one nail on each flipper. Both of these species have shells covered with smooth shields. The flesh of the Loggerhead is little cared for. It does not deposit eggs in temperate regions. This species attains a length of six feet.

Range: Tropical and semi-tropical seas.

Local distribution: An accidental visitor off the Atlantic coast.

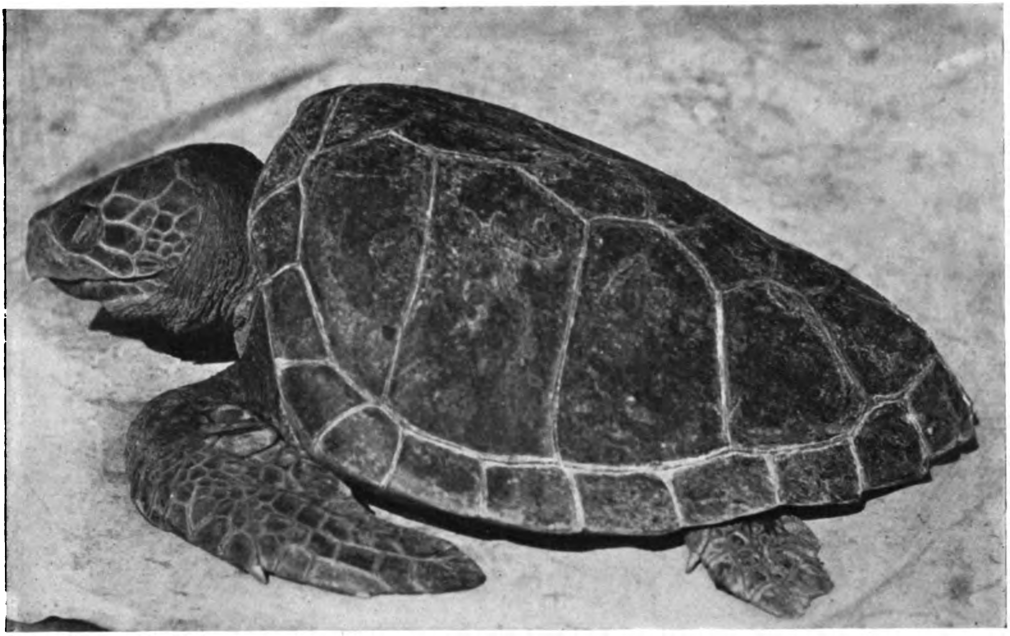


FIG. 24. LOGGERHEAD TURTLE

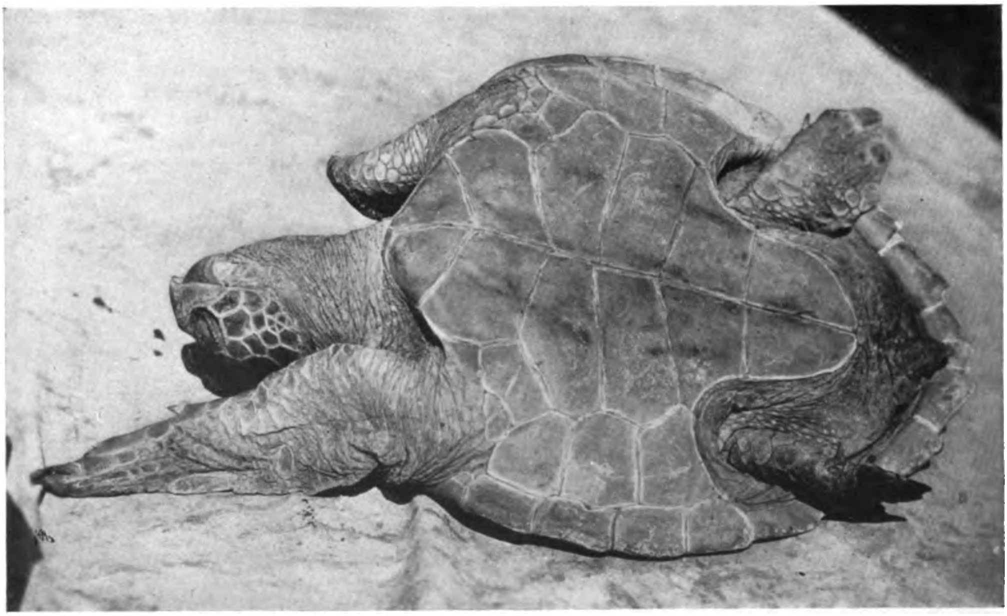


FIG. 25. LOGGERHEAD TURTLE; ON ITS BACK

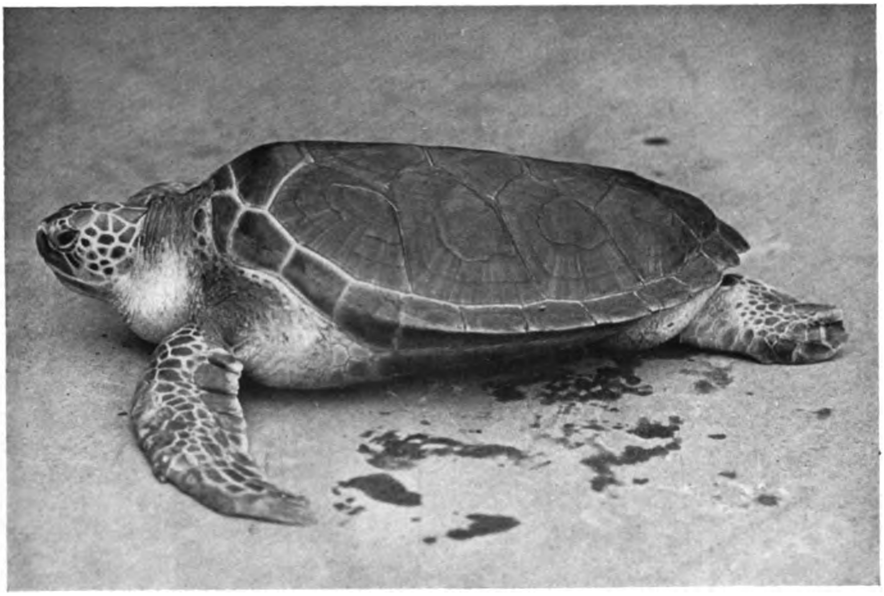


FIG. 26. GREEN TURTLE

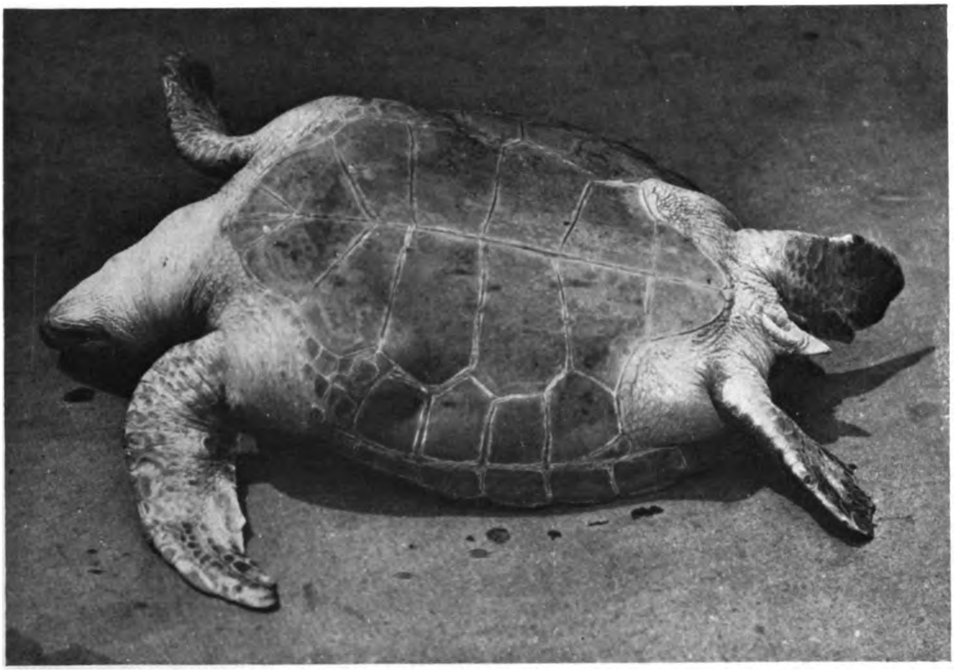


FIG. 27. GREEN TURTLE; ON ITS BACK

The Green Turtle, *Chelonia mydas* (Figs. 26, 27 and 28), is an attractive species, the coloration of the shell being a pale olive, marbled with yellow. The Green Turtle obtains its name from the distinctly green hue of its fat. Highly esteemed as an article of food, these turtles are commonly seen in the markets lying upon their backs, in which position they are helpless.[1] In tropical waters this species is alleged to attain a weight of a thousand pounds.

Green Turtle.

FIG. 28. GREEN TURTLE; HEAD

Range: Tropical and semi-tropical seas.

Local distribution: An accidental visitor off our northern seacoasts.

Snapping Turtle.

The Snapping Turtle, *Chelydra serpentina* (Figs. 29 and 30), represents the largest species of our local turtles, excepting the three already described. Its rough carapace of somber brown, with its keels and serrations, and the proportionately huge, sinister head combine to make this creature unique among our turtles. The tail is long and possesses a series of plates which form an alligator-like crest; the carapace is deeply serrated posteriorly. In proportion to

[1] The majority of the fresh-water turtles, however, when so placed, can readily roll over through the combined assistance of the head and limbs.

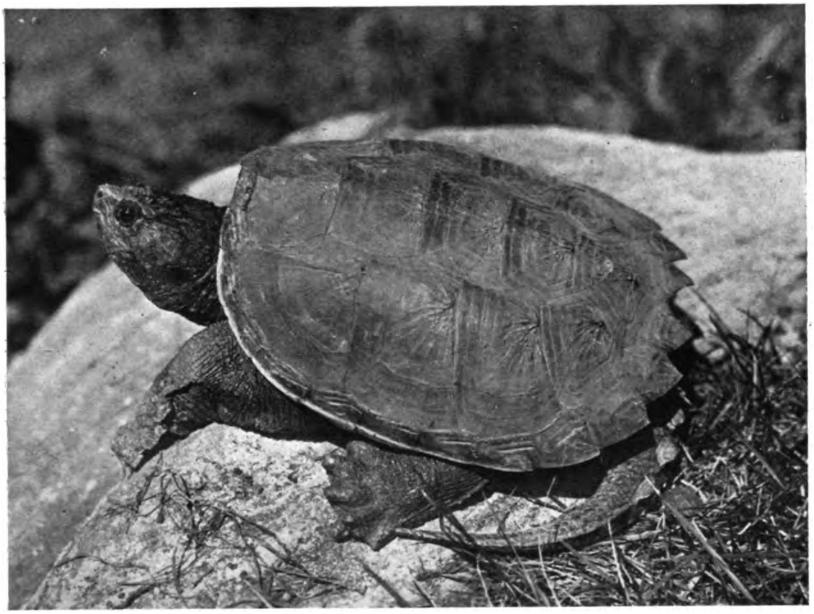


FIG. 29. SNAPPING TURTLE

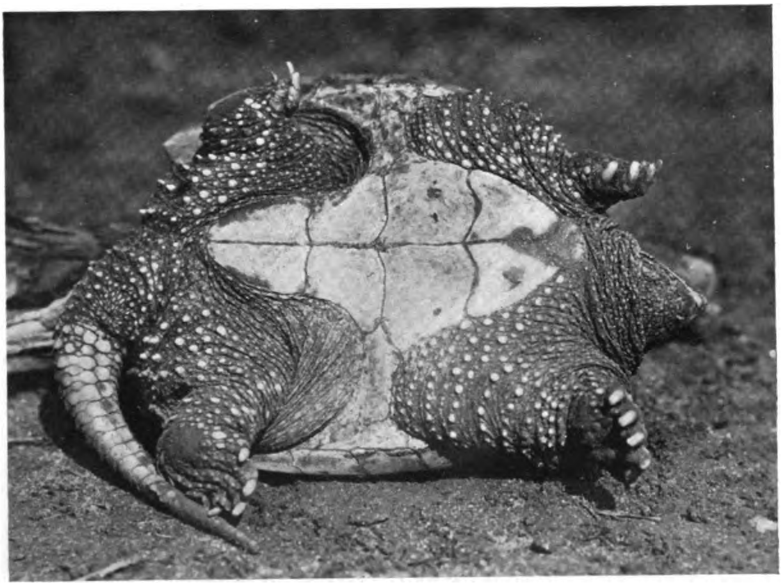


FIG. 30. SNAPPING TURTLE; ON ITS BACK

the reptile's size the plastron is very small and provides little or no protection for the limbs in time of danger. In color the Snapping Turtle is dark brown, with no markings. Adult specimens attain a length of two feet and a weight of from thirty-five to forty pounds. The carapace of old specimens is often covered with moss.

Slow-running muddy streams and large ponds are the lurking places of these reptiles, which are exceedingly voracious. Lying partly hidden in the mud, they await the approach of fish or even young water fowl. Possessed of a pugnacious disposition, a large specimen might well be rated as dangerous. The hooked jaws are capable of inflicting deep wounds, and are, moreover, employed with energy when the reptile is annoyed. When of medium size, the species is said to be edible. The eggs are deposited in June, to the number of from two to four dozen; they are perfectly spherical and possess a hard shell.

Range: Canada and the United States east of the Rocky Mountains; southward to Ecuador.

Local distribution: General and abundant.

FIG. 31. MUD TURTLE

Mud Turtle.

The Mud Turtle, *Kinosternon pennsylvanicum* (Figs. 31 and 32), is often confounded with the Musk Turtle (*Aromochelys odoratus*), which it resembles in shape and size. The principal differences between the two species are in the markings of the head and the width of the plastron. The head of the Musk Turtle shows on each side two distinct, yellowish stripes, beginning at the tip of the snout and running to the neck, and the plastron is very narrow and is much shorter than the carapace, affording little protection. The Mud Turtle, on the other hand, shows no stripes upon the head and neck; the head is irregularly speckled with green or yellow; the plastron is wide, is but a trifle shorter than the carapace, and can be closed to afford substantial protection. The average length of the Mud Turtle in this vicinity is about three and one-half inches when adult. It is not as common as the Musk Turtle.

Range: The eastern United States from New York to the Gulf of Mexico.

Local distribution: General in slow-running, muddy streams and ponds.

The Musk Turtle, *Aromochelys odoratus* (Figs. 33, 34 and 35), may be distinguished from the Mud Turtle, which it closely resembles, by the points given under the preceding caption.

FIG. 32. MUD TURTLE; ON ITS BACK

FIG. 33. MUSK TURTLE

FIG. 34. MUSK TURTLE

In some localities the Musk Turtle is very common, particularly in slow-running rivers with soft, muddy beds. When annoyed, it gives off a musky odor which is strong enough to be offensive. The carapace of an old specimen is usually so overgrown with moss as to be seen with difficulty when the animal is lying in the mud in shallow water, as is its habit. This species is frequently hooked in fresh-water fishing. In many ways the species resembles, in miniature, the Snapping Turtle. From three to four inches is the maximum size.

Musk Turtle.

FIG. 35. MUSK TURTLE; ON ITS BACK

Range: Eastern North America from Canada to the Gulf of Mexico.

Local distribution: General in slow-running streams and ponds. Occurs within the limits of New York City, and is very common in the Bronx River.

None among our turtles is better known, although possibly only by name, than the Diamond-back Turtle, or Terrapin, *Malacoclemmys palustris* (Figs. 36 and 37). The shields of the carapace rise from the surface of the shell in a series of rough, concentric rings; the row of shields down the back shows a broken keel which rises rather sharply in the center of each plate: this condition is especially

Diamond-back Terrapin.

FIG. 36. DIAMOND-BACK TURTLE (TERRAPIN)

FIG. 37. DIAMOND-BACK TURTLE; ON ITS BACK

FIG. 38. PAINTED TURTLE

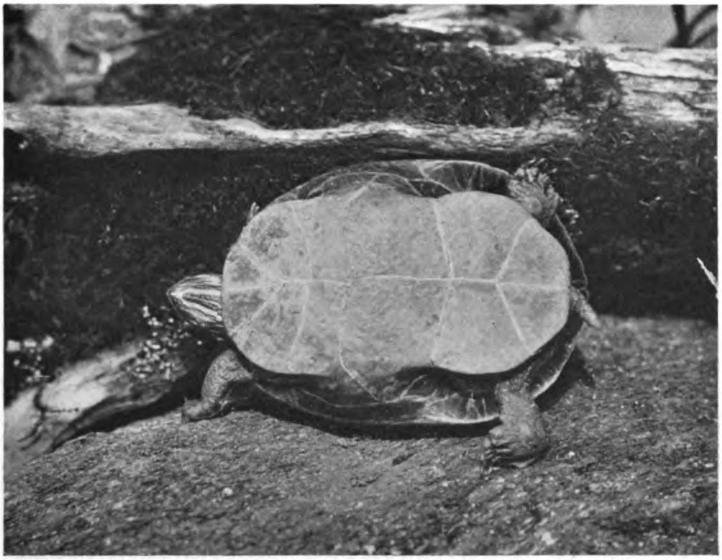


FIG. 39. PAINTED TURTLE; ON ITS BACK

prominent in young specimens and decreases with age and consequent wear of the shell. The color of the carapace is uniform green or olive, although the edges of the plates are sometimes of a slightly different shade. The general color of the limbs, head, neck and tail is pale gray, profusely spotted with black; the plastron is yellow, lined and spotted with gray.

The Diamond-back is the familiar market terrapin, and at certain times of the year sells as high as $70 per dozen. It is becoming rare in the north. Large specimens will measure ten inches in length. This is the only species of local turtle (with the exception of the Sea Turtles) that frequents salt water.

Range: The Atlantic coast from New York to Florida.

Local distribution: Salt marshes in the vicinity of Long Island Sound, Staten Island and New Jersey.

The Painted Turtle, *Chrysemys picta* (Figs. 38 and 39), is one of the most common of the local species and is easily recognized.

Painted Turtle.

The general color above is dark olive or black, with the margins of the shields of a paler shade. The margin of the under side of the carapace is black, with bright red markings; the plastron is yellow. Limbs, tail and neck, black, lined with red; head, lined with yellow. The shell of this species is flat and smooth; about five inches is the normal length.

Abundant in the vicinity of ponds, streams and marshes, these turtles may be often seen on floating logs or the like, from which they plunge quickly if alarmed. The food consists principally of small fishes and insects. Captive specimens thrive on raw chopped meat or fish.

Range: North America from New Brunswick to Georgia.

Local distribution: General and abundant.

Muhlenberg's Turtle, *Chelopus muhlenbergii* (Figs. 40 and 41), which somewhat resembles the Spotted Turtle (*Chelopus guttatus*),

Muhlenberg's Turtle.

may be easily distinguished from the latter species by the brilliant orange spot on each side of the head. The carapace is dark brown or black, sometimes marbled with light brown; the shields often show lighter margins. The shell is black beneath, blotched with yellow. The spot on each side of the head is quite characteristic. It is

FIG. 40. MUHLENBERG'S TURTLE

FIG. 41. MUHLENBERG'S TURTLE

FIG. 42. WOOD TURTLE

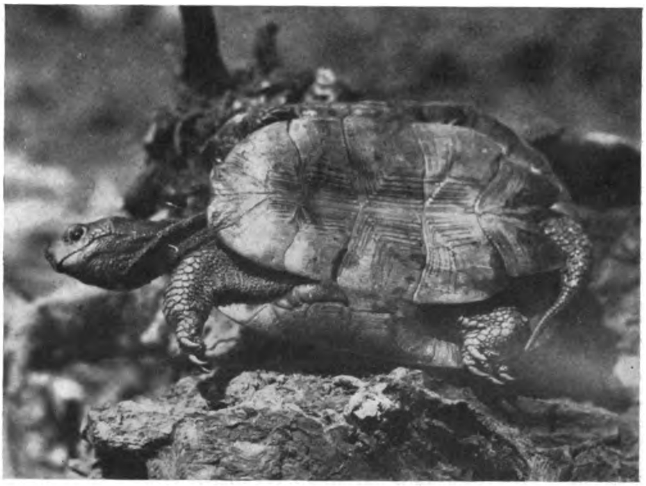


FIG. 43. WOOD TURTLE; ON ITS BACK

situated a little behind the eye and slightly above the region of the ear. The species is very rare in this vicinity. An adult specimen will measure four inches in length.

Range: Southern New York, New Jersey and eastern Pennsylvania.

Local distribution: Recorded from Staten Island and the Palisades of the Hudson River. Frequents shallow streams and swamps.

Wood Turtle.

The Wood Turtle, *Chelopus insculptus* (Figs. 42 and 43), sometimes called the Wood Tortoise, is a species quite terrestrial in habits. The general aspect of the carapace is rough, the plates being raised in concentric rings, and there is a distinct keel down the back. The color is brownish above, irregularly and rather indistinctly marked with yellow or light brown; the plastron is reddish yellow with a blotch of black on each plate; limbs, neck and fleshy parts tinged with salmon red. The head is uniform brown.

Although never found far from the vicinity of water, this species is not a water turtle, but prefers to roam about on swampy ground. In habits it resembles the Box Tortoise (*Cistudo carolina*), feeding largely upon vegetable matter. The Wood Turtle attains fairly large dimensions, the length of an adult specimen being eight inches.

Range: The northeastern United States.

Local distribution: General in swampy districts, but not common.

Spotted Turtle.

The Spotted Turtle, *Chelopus guttatus* (Fig. 44), rivals the Painted Turtle in being the most common of the local chelonians. The shell is smooth and black above with numerous round, yellow spots which vary in number on different individuals. The plastron is yellow, blotched with black. The average length of an adult specimen is four inches.

Range: Maine to South Carolina; westward to Ohio.

Local distribution: General and abundant.

The Box Tortoise, *Cistudo carolina* (Figs. 45, 46 and 47), is a strictly terrestrial species. The plastron is provided with a remarkable, practical double hinge, which is employed for pro-

FIG. 44. SPOTTED TURTLE

FIG. 45. BOX TORTOISE

tection in time of danger. When the reptile is annoyed, the front and rear sections of the plastron are pulled upwards towards the carapace, and so closely do the two shells come together that it is difficult to insert even a fine wisp of straw at any point between them.

Box Tortoise.

The Box Tortoise lives to great age, as is shown by the fact that specimens have been found upon the shells of which were names and dates that had been carved there sixty and seventy years before. Such tortoises were found near the fields in which

FIG. 46. BOX TORTOISE; ON ITS BACK

they lived when marked, hence the probability is that the animal is not a great traveler. During very dry seasons the Box Tortoise has been known to abandon the surface of the ground and burrow deeply into moist earth or mud.

Extremely variable in coloration, although the general colors are brown or black, irregularly marked with yellow, the species is more readily recognized by its form. The carapace is arched and high; the limbs are club-shaped and fitted for a terrestrial existence. Male specimens may be recognized by a distinct concave area on the rear section of the plastron and by their

red eyes. The Box Tortoise is largely herbivorous. It is very fond of berries. The length of an adult specimen is about six inches.

Range: The eastern United States.

Local distribution: General and common.

FIG. 47. BOX TORTOISE WITH CLOSED PLASTRON

BULL FROG. NEARLY NATURAL SIZE
From specimen in New York Zoölogical Park
Fig. 1 of the article on Batrachians

The American Museum Journal

VOL. V. OCTOBER, 1905. No. 4

THE major portion of this number of the JOURNAL is devoted to illustrated descriptions of the salamanders, toads and frogs which have been found within a radius of about 50 miles of New York City. This article will be published separately as No. 20 of the Museum series of Guide Leaflets, and is intended for use as a handbook for the identification of the animals in their wild state as well as in connection with the collections on exhibition in the Museum.

The collection illustrating the local batrachians may be found at present in the Synoptic Hall, No. 107 of the ground floor of the Museum Building.

The Museum gratefully acknowledges the coöperation of the New York Zoölogical Society in the preparation of the Guide. The author is Mr. Raymond L. Ditmars, Curator of Reptiles in the New York Zoölogical Park, Bronx Park, who also prepared the leaflet upon the local reptiles which was issued with the preceding number of the JOURNAL. Through Director W. T. Hornaday the abundant living material of the Zoölogical Park was placed at the disposition of the Museum for the purpose of making photographs for the illustrations, and through Director C. H. Townsend similar courtesies were extended at the New York Aquarium, Battery Park. The source of the illustrations is indicated under each figure.

THE Department of Geology has acquired a complete series of the rocks and corresponding thin sections to illustrate the latest edition of Rosenbusch's "Elemente der Gesteinslehre." This collection has been placed among the study series of the Department, where it may be examined by those interested in the subject of petrography.

HOW THE QUEENS OF THE PARASITIC AND SLAVE-MAKING ANTS ESTABLISH THEIR COLONIES.

A CONTINUATION of the author's study of temporary social parasitism among ants, briefly noticed a year ago in the AMERICAN MUSEUM JOURNAL (Vol. IV, p. 74), has brought to light some interesting facts concerning the establishment of formicaries in several of our species. It is now well known that an ant colony is started by a single fertilized female, or queen. This insect, after mating high in the air during her nuptial flight, descends, pulls off her wings, and proceeds to dig a tiny nest in the ground or in rotten wood. She closes the entrance behind her and remains secluded and without food for nine or ten months, while she lays a packet of eggs and cares for the larvæ when they hatch. Until the larvæ mature as workers, the queen feeds them with salivary secretion derived from her own fat-body and degenerating wing-muscles. These firstling workers are always small, because as larvæ they were insufficiently fed. They open the entrance to the nest, and go forth in search of food for their queen and themselves. The mother insect is now able to devote all her energies to assimilating nourishment and producing eggs, while the workers care for the brood and extend the galleries of the nest and give it whatever external architecture it may possess.

This method of colony formation, which is adopted by nearly all ants, may be called the typical method. There are, however, two other methods which are resorted to by the queens of certain species, one of a more complicated, or redundant, the other of a simpler, or defective type. The redundant type occurs among the leaf-cutting and fungus-growing ants (*Attii*) of tropical and subtropical America, in which the queen not only brings up a colony of workers by herself alone, but simultaneously keeps up a culture of the peculiar fungus which, so far as known, constitutes the only food of these ants. The defective type is found in certain ants whose queens, either because they are too small and infertile, or for some unknown reason, are unable to bring up a firstling brood without the assistance of workers of another

species. The latter method of colony formation appears under three aspects:

First, the queen may seek adoption in a moribund or queenless colony of another species and there have her young fed and reared by the alien workers. Later these die off and leave a pure colony of the parasitic species, which has now waxed sufficiently strong and independent, both in number and pugnacity, to hold its own in the struggle for existence. In the former note in the JOURNAL attention was first called to this type of temporary social parasitism in a Connecticut ant (*Formica difficilis* var. *consocians*) which, till its colony is established, lives with the common *F. schaufussi* var. *incerta*. During the past July the author was able to confirm and extend his observations on these insects. It was learned that queens of *F. consocians* were readily adopted by *incerta* workers, even when the latter had been isolated as pupæ and could not, therefore, have had any previous experience with the parasites. It was also discovered that workers of our common black ant (*Formica fusca* var. *subsericea*) could be induced to adopt solitary queens of the mound-building ant (*F. exsectoides*) and the fallow ant (*Formica rufa* subsp. *integra*). Hence it is probable that these species, which, of all our ants, develop the largest and most formidable colonies, start as humble temporary parasites in the nests of another species. Very recently Wasmann has shown that the author's conclusions are in all probability applicable also to the European ants of the *rufa* and *exsecta* groups.

The parasitic instincts of the queen ants belonging to the *rufa* and *exsecta* groups, which include *F. consocians*, *integra*, *exsectoides* and all the different forms of fallow ant (*F. rufa*) both of Europe and America, are probably traceable to a peculiarity of the adult colonies of these insects. It is known that these colonies sometimes consist of dozens of different nests, which have all been founded by young fertilized queens, accompanied by a number of workers of their own species, as offshoots from the original nest, that is, the one first established through temporary social parasitism. This habit of propagating a colony over several nests often many feet apart, has probably been the means of depriving the queens of the *rufa*

group of their primitive ability to establish colonies exclusively through their own initiative. Hence when, during their nuptial flight, they drift too far away to find workers of their own colony or species at hand to assist them, they are compelled to solicit the aid of workers of another species. The extremely common, widely distributed, and very cowardly ants of the *fusca* and *schaufussi* groups are the ones naturally exploited for this purpose. In the species of the *rufa* group with large queens we probably still have the earlier phylogenetic stages of this development: the parasitic instinct is highly developed, but the stature of the ants has as yet undergone little or no diminution. In the species with diminutive queens, however, like *F. nepticula*, *microgyna* and *consocians*, we have the last stages in this retrogressive development, since the inability of the queen to establish a colony unaided is manifested not only in her parasitic instincts, but also in her diminutive size and frail structure.

Second, the queen may not only seek adoption among alien workers, but she and her progeny may continue to live with their hosts as permanent parasites. This seems to be the case in some of the European ants of the genus *Strongylognathus* and in the workerless species of *Anergates*, *Epœcus*, *Epipheidole* and *Sympheidole*.

Third, the queen may compel her own adoption or may snatch away the pupæ of an alien species and leave to the workers that hatch from them the care of bringing up her own offspring. These may, in turn, take to robbing the worker pupæ from other colonies of the host species and in this manner keep up a permanent mixed colony. This is slavery, or "dulosis," as practiced by the sanguinary ants (*Formica sanguinea*) and the amazon ants (*Polyergus rufescens*) of Europe and their American subspecies and varieties.

Experiments on artificial colonies of *F. sanguinea* subsp. *rubicunda* Emery have given an insight into the method in all probability adopted by this insect while founding its colonies under natural conditions. A detailed account of these experiments will be published in the near future, but the results may be here briefly stated. When a female *rubicunda* from which the wings have been removed is confined in an artificial nest

with as many as twenty workers of *F. fusca* var. *subsericea* and their brood, she is received with great hostility. At first her conduct is patient and insinuating, or even somewhat timid, but the persistent pulling and tweaking to which she is subjected by the workers soon throws her into a frenzy of rage. She falls upon her tormentors, drives them from their brood and, when they persevere in returning, kills them one by one. With feverish haste she then appropriates the pupæ, secretes them in some corner and carefully guards them, ever on the alert with open mandibles to attack an intruder, till the workers are ready to hatch. She deftly frees the pale drab callow young from their pupal envelopes, and immediately adopts them, thus quickly surrounding herself with the means of nourishing both herself and her own progeny as soon as the latter are brought forth. The immediate result of these tactics is to produce a small mixed colony consisting of a female of one species of *Formica* and a number of workers of another, exactly as in the *consocians-incerta* colony, but with the interesting and important difference that in this case the *incerta* workers are effete or moribund, or at any rate older than the queen, whereas the *subsericea* workers in the case of *rubicunda* are younger than the queen and have before them a lease of life amounting to three or four years. The result, moreover, in the case of *rubicunda* is not achieved passively, by adoption of the queen, as in *consocians*, but actively, by conquest and abduction. Of course, none of these differences is apparent from mere inspection of an incipient mixed colony of *consocians* or *rubicunda*, but can be ascertained only through studying the behavior of the queen during the period that elapses between the nuptial flight and the establishment of her colony.

The author's experiments with queens of our shining amazon (*Polyergus rufescens* subsp. *lucidus*) and workers of the species which it enslaves (*Formica schaufussi*) have, up to the present time, given contradictory results. All of these queens, when introduced into artificial nests containing *schaufussi* workers, were violently attacked. Some of them retaliated by ruthlessly killing all the latter, but remained perfectly indifferent to their larvæ and pupæ. Other queens, however, were more insinuating and far less bloodthirsty and, though equally indifferent

to the *schaufussi* young, seemed to be seeking adoption. Perhaps the method of colony formation resorted to by these insects may vary according to circumstances. It is certain, however, that the establishment of a colony must be attended with great difficulties or be possible only under unusual conditions, since the amazon ants are very rare and local in their occurrence.

WILLIAM MORTON WHEELER.

CIRCULATING INSECT COLLECTIONS.

A notable addition to the circulating school collections is the special insect collection, fifty sets of which have been prepared. Each collection consists of four trays, 9 x 7 x 1½ inches, which are made so that they can be removed from the transportation case and passed around the class. The first tray shows the life history of the Cecropia Moth, comprising eggs, caterpillar, chrysalis, cocoon and adult. Since it is impossible to preserve the caterpillar in a lifelike condition, there has been substituted for it a hand-colored lifesize photograph showing a caterpillar on the twig of an alder, one of the many plants upon which it feeds. This photograph serves as a background for the group. To one of the leaves are attached the eggs, and the moth is mounted as if alighting on the alder twig. The second tray contains the development of the Monarch or Milkweed Butterfly for comparison with the Cecropia. A hand-colored photograph from life shows the caterpillar (natural size) feeding on a spray of milkweed. In the third tray is shown the life and work of the Honey Bee. The series contains queen, drone, worker, larva, pupa, drone cells, section of drone cells, worker cells, section of worker cells, queen cells, wax, propolis, artificial foundation, honeycomb ready to receive the honey, cells filled with honey and a vial of pure honey. The fourth tray shows the household-insects and contains fourteen species of our most common household pests, including the house-fly, roach, clothes moth, mosquito and some species particularly familiar in crowded tenement districts. The notes which accompany each collection give the habits and economic importance of the insects, and, in the case of the household pests, the best methods of exterminating them.

THE ANATOMY OF THE COMMON CLAM

From model about seven times natural size prepared by Dr. B. E. Dahlgren

DEPARTMENT OF PREPARATION AND INSTALLATION.

WE present with this number illustrations of the enlarged models representing the anatomy of the common oyster and clam, which have been prepared by Dr. B. E. Dahlgren, Curator of the Department, and placed on exhibition in the Synoptic Hall, No. 107 of the ground floor. These models are about seven times natural size, and show very clearly the names and functions of the different parts of the animal.

CLAY MODEL OF POLAR BEAR GROUP

The preparation of a large group to represent the Polar Bear in his native surroundings has been begun by the Department of Preparation and Installation. It may interest our readers to know that the first step in the actual preparation of such a group is the making of a complete model in clay, which represents not only the background, but also all the animals in the position and attitude which they will occupy in the completed work. A photograph of such a preliminary model of the Polar Bear group is reproduced herewith. The animals here utilized were captured on some of the Peary Arctic expeditions.

Several striking and instructive models in glass, wax and other materials have been placed on exhibition in the Synoptic

Hall, No. 107 on the ground floor. The models represent the anatomy of the Nemertean, one of the worms, enlarged about 15 diameters; Porpita, a form related to the Portuguese Man-of-War, enlarged about 10 times; a Cladactis, which is a beautiful sea-anemone flourishing in the Gulf of Naples; a Sea-fan, enlarged 3 diameters; a Goniomus, one of the jellyfishes, enlarged 6 or 8 diameters, and some of the Bryozoa, much enlarged.

A group illustrating the Peccary has been installed in the East Mammal Hall, No. 206, which was prepared in the Department from animals collected by J. H. Batty and accessory material collected by Dr. B. E. Dahlgren.

Among other groups which have been recently prepared at the Museum and placed on exhibition mention may be made of that representing the Iguana, the great edible lizard of tropical America, and that of a poisonous lizard closely allied to the Gila Monster. The animals for these groups were collected in Mexico by Mr. J. H. Batty.

MUSEUM NEWS NOTES.

A LARGE specimen of the Leather-back Turtle (*Dermochelys coriacea*) was received in the flesh early in July as a gift from Messrs. G. M. Long & Co., New London, Conn. The dimensions of the animal were, carapace, 4 feet 10 inches long; body, 6 feet long over all; spread of flippers, 7 feet; weight as determined at the Museum, 716 pounds. A plaster cast of the specimen was made at once, which will soon be placed on exhibition. The turtle was harpooned about 30 miles east of Block Island by Captain Hoyt, of the fishing-smack Lizzie M., of Bridgeport, Conn., while on a cruise for sword-fish.

THE Museum has recently received from Alaska the material for completing the group of the Alaska Brown Bear. The animals were collected on Museum expeditions by Mr. Andrew H. Stone. The accessories were kindly collected and presented by Mr. H. B. Scott, of Sand Point, Alaska.

THE St. Louis World's Fair Exhibit of the New York City Board of Education, which was displayed for several months at

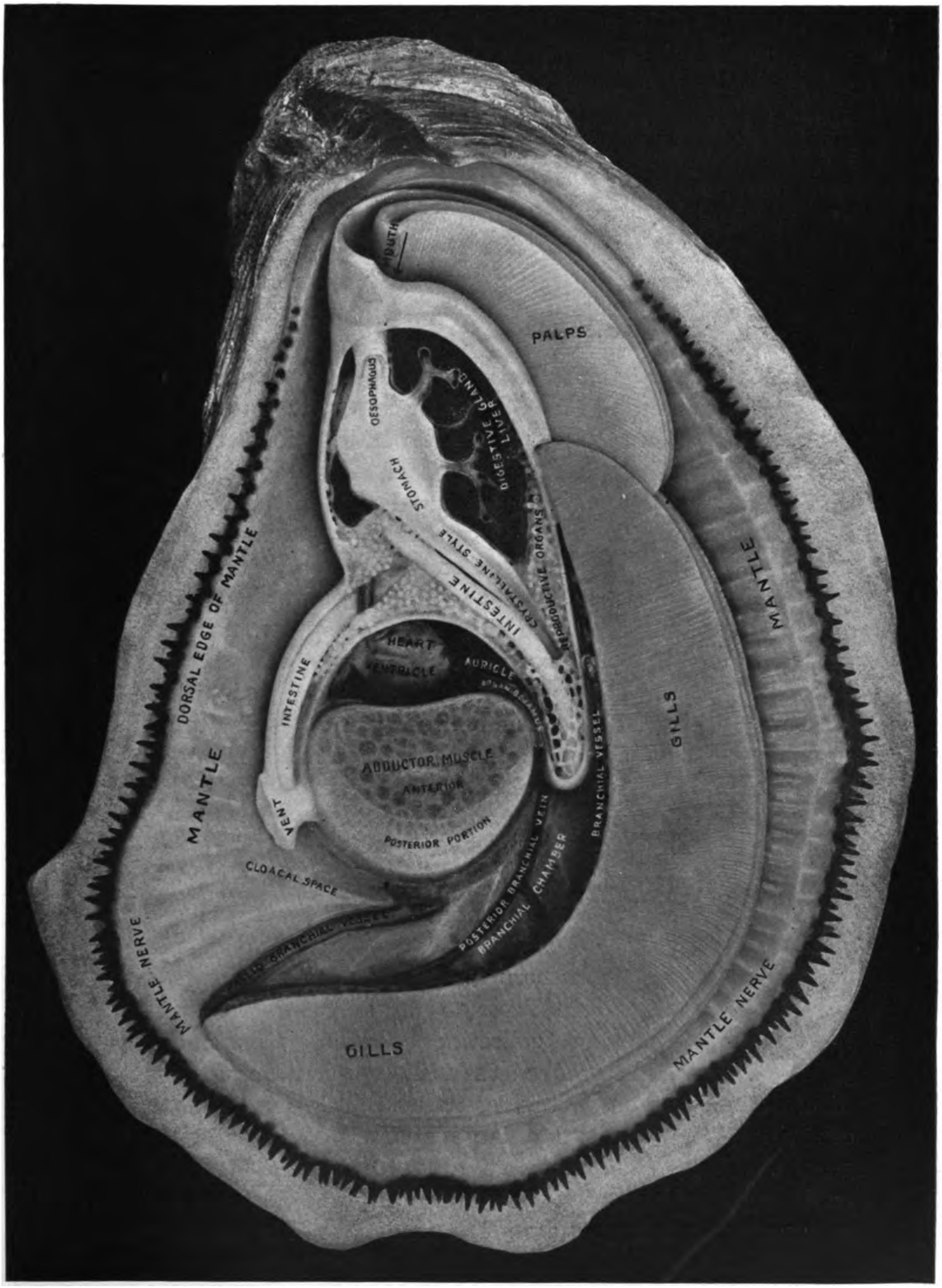
the Museum and which attracted thousands of visitors, has been removed.

The New York City Board of Health has installed in the West Assembly Hall on the ground floor of the Museum the material which formed its exhibit at the Louisiana Purchase Exposition in St. Louis last year.

There has been a greater demand than ever on the part of the vacation schools for our nature-study collections which are loaned to public schools. Thirty-two out of the thirty-three vacation schools in session during the summer have been supplied with collections, and, according to data furnished by the teachers, they have been studied by more than 40,000 school children. This number makes a total of 365,000 children who have studied the collections during the past school year.

At the request of the Librarian of the 176th Street Branch of the New York Public Library, the Museum has loaned a collection, consisting of local birds, insects and marine animals, for exhibition in the reading-room of that branch. In response to a similar request, an archæological collection has been placed in the Tompkins Square Branch, East Tenth Street. In this collection are shown the stone and bone implements that were made and used by the prehistoric Indians. The collections have proved so interesting and instructive to adults as well as to children, that Dr. Arthur E. Bostwick, Chief of the Circulating Department, has asked for the extension of similar privileges to other branch libraries.

At a meeting of the students of the Summer School of Columbia University, held at the Museum on July 26, Mr. George H. Sherwood gave an informal talk on the Museum's work of loaning nature-study collections to public schools and of giving lectures for school children. Mr. F. M. Chapman spoke on Museum methods in the collecting of scientific data and materials, with special reference to his studies in the flamingo colonies of the Bahama Islands. Mr. Chapman illustrated his talk with lantern slides made from some of the remarkable photographs



THE ANATOMY OF THE COMMON OYSTER

From model about seven times natural size prepared by Dr. B. E. Dahlgren

taken by him in the field. After the lecture the students were taken to the flamingo group and were shown some of the practical results of the expedition which had been described. The majority of the students were public school teachers from Southern and Western States, and they were much interested in these phases of the Museum's work.

THE generosity of a friend of the Museum enables the Department of Ornithology to plan to assemble a special collection of Birds of Paradise. Many species of this remarkable family of birds are now becoming so rare that specimens can be secured only with difficulty. Mr. Chapman, Associate Curator of Ornithology, while attending the Fourth International Congress of Ornithologists in London recently, took advantage of the occasion to examine the stocks of London dealers in Natural History supplies and was fortunate in procuring some most desirable material for use in the proposed group.

THE collections of native birds were so popular last year that the Museum was unable to fill all the requests for them. The duplicate material in our study collections which could be used for this work has long since been exhausted, and during the summer the Museum has purchased more than six hundred bird skins to supplement our present collections. These have been mounted, and there are now two hundred cabinets of birds alone available for school use.

MR. J. H. BATTY, who has been collecting mammals, birds, and reptiles for the Museum in Mexico for several years past, finished his work in southern Sinaloa in November last, going thence overland through Tepic to Jalisco, where he has since been making important collections. Several shipments from Jalisco have already reached the Museum, containing hundreds of birds and mammals, besides many reptiles and insects, accessories for groups and a large number of valuable photographs. During the last two or three months he has been exploring the fauna of Mount Colima and the adjacent regions, with very interesting results. His collections of birds and mam-

mals thus far received number several thousand of each and include several hundred specimens of the large mammals, such as Deer, Peccaries, Coyotes, Coatis and Ocelots. He has shown himself particularly successful in hunting large game, and his industry and endurance often attain success where a less energetic and less resourceful collector would meet with failure.

Lieutenant G. T. Emmons, of the United States Navy, retired, has deposited in the Museum several remarkable specimens from Lytton, British Columbia, which are different from anything known from there in 1897, when the monograph on the Archæology of Lytton was published by the Museum in 1897.

The Royal Ethnographical Museum of Berlin has sent, for exchange with the Museum, six casts of sculptured clubs made of whale bone, from Vancouver Island. These have been drawn for illustration, for comparison with specimens collected by the Jesup Expedition, in one of its forthcoming monographs, wherein will be portrayed as complete a series of such clubs as it is possible to obtain.

The Museum has received from the Missouri Historical Society, as a gift, a model of the Cahokia Mound in Madison County, Illinois, as it was in 1878. This mound is of the form of a truncated pyramid and is the largest in the United States, being some 1100 feet long and more than 100 feet high. It covers more ground than the largest Egyptian pyramid. With this model was another, made by Mr. John R. Patrick, showing the mound restored to its supposed original form.

The Department of Anthropology has received as a gift from Mr. T. Van Hyning of the State Historical Department of Des Moines, Iowa, a series of grooved axes, celts and stone disks which is particularly welcome, since the Museum previously had only two archæological specimens from that State.

Mr. David Ashworth, of Wappinger's Falls, New York, has kindly loaned to the Museum a series of characteristic archæological specimens collected by him at the time of the construction

of the Canadian Pacific Railroad through British Columbia. Such of these as supplement the large collection made by the Jesup expedition are being cast and the casts are being colored for exhibition in the Museum. These specimens are also being illustrated and described for publication in a memoir of the Jesup expedition on the Archæology of Puget Sound.

Mr. Frank G. Speck, who has been engaged in field work in Indian Territory for the Department of Ethnology, has suffered sunstroke. While he is not in danger of his life, this unfortunate occurrence will greatly interfere with the work for which he is particularly fitted.

Dr. P. E. Goddard, of the University of California, has completed the field work in Ethnology which he undertook last summer among the Sarcee Indians of Canada for the American Museum. His collection, which has been received here, includes several important medicine objects.

Mr. W. C. Orchard has made a number of tepee models, showing the methods of tying the poles, decorating the outside and arranging and furnishing the interior. These have been installed in the west wing, ground floor. In the same hall an exhibit has been made of a Blackfoot Medicine Pipe, showing its place in the tepee when in use, together with the numerous objects pertaining to it. This medicine outfit has an elaborate ritual with seventy songs, all of which have been recorded with a phonograph and preserved by the Museum.

Mr. R. H. Lowie has installed an exhibit of primitive fire-making in the West Wing of the second floor (Hall No. 202). Since it was by the use of fire that mankind advanced from a merely animal mode of life to the present level of material culture, an exposition of the methods by which the different peoples obtained fire forms the first chapter in the history of civilization. This exhibit demonstrates the fact that practically all people used some kind of wood friction to get the first spark of artificial light and heat.

An unusually fine collection of Orthoptera has been purchased from Prof. Lawrence Bruner, of Lincoln, Nebraska. The collection contains 255 species and about 825 specimens.

LECTURES.

MEMBERS' COURSE.

The first course of lectures for the season 1905–1906 to members of the American Museum of Natural History and those holding complimentary tickets given them by Members, will be given according to the following programme. The lectures will be delivered by members of the scientific staff of the Museum and will be fully illustrated by stereopticon:

Thursday evenings at 8.15 o'clock.

November 9.—Mr. Frank M. Chapman, "The Bird Life of Florida."

November 16.—Mr. Louis P. Gratacap, "Newfoundland: Its Scenery and People."

November 23.—Dr. Edmund Otis Hovey, "Northern Mexico: Its Deserts, Plateaux and Canyons."

December 7.—Professor Henry Fairfield Osborn, "The Museum's Rocky Mountain Explorations of 1905."

December 14.—Professor Albert S. Bickmore, "The Philippines—Manila."

December 21.—Professor Albert S. Bickmore, "The Philippines—Luzon."

PUPILS' COURSE.

The lectures by members of the scientific staff of the Museum to pupils of the public schools and children of Members of the Museum will be resumed about the middle of October. The course, which is on topics supplementary to school work in nature study, geography and history, consists of twelve lectures, each of which is given three times. The lectures will be delivered Mondays, Wednesdays and Fridays at 4 P.M., and will be open to public-school children when accompanied by their teacher, and to the children of Members on presentation of their membership ticket. Additional particulars may be learned by addressing the Director of the Museum.

PEOPLE'S COURSE.

THE programme of the Free Lectures to the people which are given Tuesday and Saturday evenings in co-operation with the Department of Education of the City of New York for the first course of the season 1905–1906 is as follows:

Twelve lectures upon European geography, all illustrated by stereopticon views, on Tuesdays at 8 P.M.

October 3.—MR. FREDERICK E. PARTINGTON, "Sweden and Denmark."

October 10.—MR. FREDERICK E. PARTINGTON, "Norway."

October 17.—DR. JOHN C. BOWKER, "Japrussa." A Comparative Study of Russia and Japan.

October 24.—MR. FREDERICK E. PARTINGTON, "Imperial Austria."

October 31.—MR. FREDERICK E. PARTINGTON, "The Dolomite Alps and the Southern Tyrol."

November 7.—MR. E. CLOWES CHORLEY, "A Tramp through Switzerland."

November 14.—PROF. HENRY ZICK, "The Rhine and the Black Forest."

November 21.—PROF. HENRY E. NORTHROP, "Imperial Berlin."

November 28.—DR. WILLIAM E. GRIFFIS, "The Dutch at Home, and their Grand Story."

December 5.—DR. WILLIAM E. GRIFFIS, "Social, Artistic and Literary Holland."

December 12.—MR. ERNEST R. HOLMES, "Paris, City of Light."

December 19.—MR. ERNEST R. HOLMES, "How France is Governed."

Twelve lectures upon natural science on Saturdays at 8 P.M. A course of six lectures on Evolution by PROF. SAMUEL C. SCHMUCKER:

October 7.—"A Master Mind." An account of the life and work of Charles Darwin.

October 14.—"His Master Idea." Natural Selection.

October 21.—"Down through the Past." Geological History.

October 28.—"What a Chicken can Teach us." Illustrated.

November 4.—"The Humming Bird's History." Illustrated.

November 11.—"The Flower's Best Friend." Illustrated.

Three illustrated lectures on the Industries of Animals by PROF. CHARLES L. BRISTOL:

November 18.—"Hunting and Fishing."

November 25.—"Methods of Defence and Care of Young."

December 2.—"Construction of Dwellings."

Three illustrated lectures on Forestry by MISS GRACE E. COOLEY:

December 9.—"How the Forests Pay their Rent."

December 16.—"The Struggle for Existence from the Standpoint of a Tree: Ingenious Methods of Winning Success."

December 23.—"Forestry and the Citizen."

The lectures of the People's Course are open free to the public, and no tickets are required for admittance, except in the case of children, who will be admitted only on presentation of the ticket of a Member of the Museum. The doors are open at 7.30 and are closed when the lectures begin.

MEETINGS OF SOCIETIES.

The meetings of the various societies that make the Museum their home will be resumed the first week in October. Papers on technical and general scientific subjects are read before these societies. The papers and discussions are often of popular character and are always of considerable general interest. The public is invited to attend the meetings, and Members of the Museum, on making request of the Director, will be provided with programmes of the meetings as they are published.

The New York Academy of Sciences will begin its sessions for the season of 1905–1906 on Monday, October 9, at 8.15 P.M., with a business meeting and meeting of the Section of Geology and Mineralogy. The programme will be as follows:

PROFESSOR ROBERT T. HILL, formerly of the United States Geological Survey, will lecture on "The Republic of Mexico: Its Physical and Economic Aspects." Professor Hill has devoted more than twenty years to the study of Mexico, and his lecture embodies the results of extended, careful, and systematic research. The attention of the general public is particularly called to this meeting of the Academy, and those interested in our sister republic are cordially invited to attend. The lecture will be given in the Auditorium, and will be fully illustrated with stereopticon views.

The Academy meetings for the remainder of the month will take place as follows:

October 16.—Section of Biology.

October 23.—Section of Astronomy, Physics and Chemistry.

October 30.—Section of Anthropology and Psychology.

After October throughout the season the Academy will hold its meetings as follows, at 8:15 P.M.:

First Mondays.—Business meeting and Section of Geology and Mineralogy.

Second Mondays.—Section of Biology.

Third Mondays.—Section of Astronomy, Physics and Chemistry.

Fourth Mondays.—Section of Anthropology and Psychology.

On Tuesday evenings, as announced by the secretaries, meetings are held by the New York Linnæan Society, the New York Mineralogical Club and the New York Entomological Society.

THE BATRACHIANS OF THE VICINITY OF NEW YORK CITY.[1]

BY RAYMOND L. DITMARS,

Curator of Reptiles, New York Zoölogical Park.

With Illustrations from Photographs Taken from Life

BY HERBERT LANG,

American Museum of Natural History.

INTRODUCTION.

FOLLOWING the reptiles in zoölogical classification come the batrachians, creatures which may be said to constitute a connecting link between the reptiles and the fishes. Unlike the former, the great majority of batrachians begin life as strictly aquatic, fish-like forms, provided with gills, which with many species are elaborately developed in the shape of external, fringed processes. From this aquatic form, with gills (the tadpole or larval stage), the average batrachian ultimately matures into a creature constituted to breathe atmospheric air.

Swamps and bogs and the borders of streams and ponds are usually the homes of the batrachians, which thrive in such damp situations. Some species, like the toad, are quite terrestrial, and many are subterraneous, but with few exceptions they frequent the immediate vicinity of water or damp and shaded places. There are species that remain aquatic throughout life, like the Mud Puppy (*Necturus*) and the Hellbender (*Cryptobranchus*), both North American species. In the Old World is found the *Proteus*, a blind and translucent species, that passes its entire existence in underground rivers or in the dark lakes of European caverns.

[1] Issued also in separate form as **Guide Leaflet** No. 20.

With but few exceptions the mature batrachians differ from the reptiles in the total absence of scales. Their naked, usually slimy skin at once defines them to the novice. The few scaled species indicate their scalation only upon close examination, and beneath the shining skin may be discerned a fine dermal texture. No species among the local batrachians possesses scales.

In our local fauna, two orders of the Batrachia are represented. These are the *Urodela*, comprising Salamanders and Newts, and the *Salientia*, or Tailless Batrachians (the Toads and Frogs).

SALAMANDERS.

Order *Urodela.*

The salamanders and the newts may be easily recognized by their lizard-like form, but even the novice may at once distinguish them from true lizards by their moist or slimy, naked skin, totally devoid of scales. Many of the semi-aquatic species, however, are actually known in the regions they inhabit as water "lizards."

The majority of the local species begin life, like the frogs and toads, as tadpoles, hatching from opaque eggs which are deposited in streams and ponds. Unlike the frog larva however, the tadpole of the salamander retains throughout the larval state external gills, arranged in three tufts on each side of the head. These gills are delicately fringed and enable the young creature to lead a fish-like existence. The presence of these organs enables the observer to distinguish at a glance the larvæ of the salamanders and newts from those of the frogs and toads. Apart from the gills, however, the salamander tadpoles differ from the tailless batrachians in the development of the limbs. The front limbs are the first to appear, an external character quite reversed among the frog larvæ. Though the development with the latter is the same as with the salamanders, the growth of the front limbs goes on under cover of the operculum, while the hind limbs are attaining external development. When the front limbs attain their growth, they push their way suddenly through the folds of the operculum and into view.

A few of the local salamanders, represented by the genera

Plethodon and *Hemidactylium*, undergo their metamorphosis in damp places under stones or logs in the woods. The young of these possess branching gills when hatched, but the gills are absorbed within a few days.

In the vivarium, many of the salamanders may be kept for observation by providing them with some three inches of damp *Sphagnum* moss, over which have been placed strips of old bark. The moss should be kept very damp. Ant larvæ, the grubs of the smaller wood-boring beetles and small earthworms serve as food.

If these creatures were provided with scales like the reptiles, the making of a popular key for identification would be simple. There is, however, among most salamanders a peculiar uniformity of external surface and general structure. Technical divisions of the *Urodela* are founded upon the arrangement of the teeth, the anatomical structure of the tongue, the shape of the tail and the development of the toes. In the preparation of the following key, however, the writer has relied upon the few characters that appeal to an observer not versed in technical terms. The characters employed pertain to variation of *outline*, where such exists, *size* and *color-pattern*. In our local fauna four families, comprising twelve species and two varieties, are represented. These are, the AMBLYSTOMIDÆ, represented by *Amblystoma opacum*, *A. tigrinum*, *A. punctatum;* the PLETHODONTIDÆ, *Plethodon glutinosus*, *P. cinereus*, *P. cinereus erythronotus*, *Hemidactylium scutatum*, *Spelerpes ruber*, *S. bilineatus*, *S. longicauda;* the DESMOGNATHIDÆ, *Desmognathus fusca*, *D. ocrophæa;* the PLEURODELIDÆ, *Diemyctylus viridescens*, *D. viridescens miniatus*.

Key to the Salamanders.

a. FORM STOUT, SIZE LARGE.

1. *Tail flattened towards the tip.*

Black, marbled with grayish white blotches............ **Marbled Salamander** (*Amblystoma opacum*).

Black, marbled with yellow, the yellow predominating... **Tiger Salamander** (*Amblystoma tigrinum*).

Black, two rows of yellow spots, black predominating. **Spotted Salamander** (*Amblystoma punctatum*).

b. BODY CYLINDRICAL, ELONGATED.

1. *Tail rounded.*

Size moderate; black, with silvery spots..............	**Slimy Salamander** (*Plethodon glutinosus*).
Size very small; brown, with minute white dots.........	**Gray Salamander** (*Plethodon cinereus*).
Size very small; dark gray, a reddish band on back......	**Red-backed Salamander** (*Plethodon cinereus erythronotus*).

2. *Tail bluntly oval.*

Size small; snout very blunt; brown, paler on back......	**Four-toed Salamander** (*Hemidactylium scutatum*).

3. *Tail flattened towards the tip.*

Size moderate; bright red, spotted with black........	**Red Salamander** (*Spelerpes ruber*).
Size small; yellow band on back, dark bands on the sides......................	**Two-lined Salamander** (*Spelerpes bilineatus*).
Size larger; yellow, sides with many black spots and a median dorsal series thereof; tail keeled above, very long.	**Long-tailed, or Cave Salamander** (*Spelerpes longicauda*).
Size moderate; gray, minutely dotted with white; greater length of tail flat..........	**Dusky Salamander** (*Desmognathus fusca*).
Size moderate; brown, lighter on head; basal half of tail rounded..................	**Mountain Salamander** (*Desmognathus ocrophæa*).

c. OUTLINES WELL PROPORTIONED; SIZE SMALL.

1. *Tail flat from base to tip.*

Skin smooth; tail fin-like; olive above, yellow beneath, a row of red spots on side; aquatic..................	**Water Newt** (*Diemyctylus viridescens*).
Skin rough; tail thicker; reddish brown to vermilion; terrestrial................	**Red Eft; Mountain " Lizard "**(*Diemyctylus viridescens miniatus*).

Descriptive List of the Salamanders.

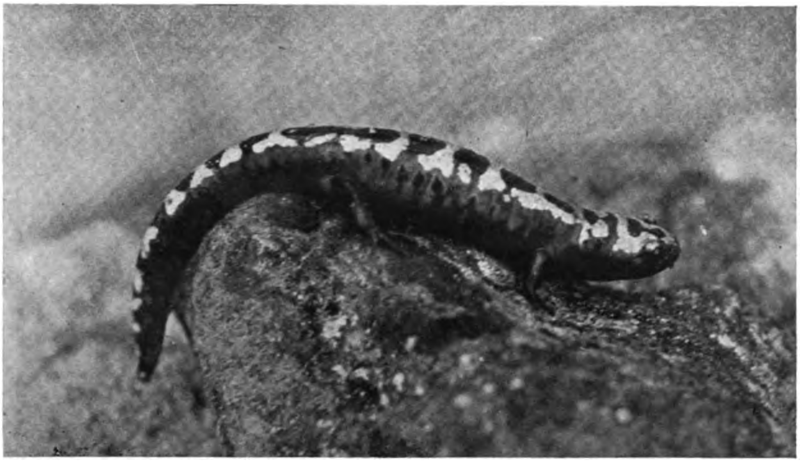


FIG. 2. THE MARBLED SALAMANDER
From specimen in New York Aquarium

Marbled Salamander.

The Marbled Salamander, *Amblystoma opacum* Gravenhorst (Fig. 2), is of moderate size and stout form, with flattened tail, which is thick at the base. General color slaty-black, with large elongated spots or blotches of grayish-white on the back and head. Some of the spots run together, producing a marbled appearance, a character which occurs on the back of many specimens. The spots are regularly disposed as half-rings on the upper surface of the tail, producing a banded appearance. Beneath, this species is a uniform bluish-black. It may be distinguished from the other local representatives of the genus by its grayish-white markings, the other species possessing yellowish markings. Total length, 4¾ inches; length of tail, 2 inches.

Range: The eastern and central portions of North America.

Local Distribution: General in this vicinity, but not common.

The larvæ of the marbled Salamander may be found in shallow ponds in the openings of woods. They grow rapidly and leave the water late in June or early in July. While developing, they present a dull, grayish appearance, thickly dotted with white, which pattern gives way to the markings of the adult a short time prior to their leaving the water. In the adult form this salamander selects dry situations, and may be found under stones in sandy, or dry and hilly country, where it burrows to some depth.

FIG. 3. THE SPOTTED SALAMANDER
From specimen in New York Zoölogical Park

The Spotted Salamander, *Amblystoma punctatum* Linn. (Fig. 3), is a large form with stout body and broad head. The tail is rounded at the base, but bluntly compressed towards the end. Black above, with a row of round brilliant-yellow spots on each side. This row extends to the tip of the tail and is a ready means of identification. There are several of these spots, too, on the upper surface of each limb. The lower sides are slaty-gray, sprinkled with small, bluish-white spots. In form the Spotted Salamander slightly resembles the Tiger Salamander, but may be distinguished therefrom by the

Spotted Salamander.

regularity of its color pattern. Total length, 7½ inches; length of tail, 3¾ inches; width of head, ¾ inch.

Range: Eastern and central North America.

Local Distribution: Sparing, in damp woods.

The eggs are deposited early in the spring in ponds and small streams. They resemble the spawn of frogs. The adult may be found under logs and stones in thinly timbered sections. Like the other species of this genus, this salamander will live for years in the vivarium.

FIG. 4. THE TIGER SALAMANDER
From specimen in New York Zoölogical Park

Tiger Salamander.

The Tiger Salamander, *Amblystoma tigrinum* Green (Fig. 4), is a large species with stout body, flat head and compressed tail. Ground color above, dark brown or gray (sometimes black), thickly covered with large, irregular, yellowish blotches. The blotches predominate and impart a marbled appearance to the animal. On the lower portions of the sides the yellow is present in the form of round spots, or scattered blotches, and the ground color is lighter. The chin is thickly marked with yellow, but little of the color is apparent on the abdomen, which is gray. The intensity of the markings depends much upon the age of the individual. Very old specimens show a faint pattern and in some lights appear to be of a dull, uniform

brown. This is the largest of our salamanders. Although in form resembling the Spotted Salamander, its blotched appearance makes identification easy. The limbs are large and well developed. A mature specimen from New Jersey shows a total length of 8½ inches; the tail is 3¾ inches long, and the head ¾ inch wide. The species is said to attain a length of eleven inches.

Range: The entire United States and southern Canada; northern and central Mexico.

Local Distribution: Rare, but found occasionally on Long Island and in New Jersey.

Although one of the rarest of the local batrachians, the Tiger Salamander is our most interesting species. The metamorphosis from the larval to the adult form depends largely upon light and temperature, and is strongly influenced by surrounding conditions. In the western and southwestern portions of the United States it is abundant, and throughout those areas, for many years, its larval or tadpole stage was thought to constitute a distinct species, the Axolotl. In permanent lakes of some depth, where the water remains moderately cold and there is abundance of food suitable for the larval form, this creature evinces an interesting persistency in retaining the branching gills (branchiæ) and continues its aquatic existence for indefinite periods even attaing the size of the terrestrial form.

More remarkable, however, than tardy metamorphosis is the fact that during this evidently larval state these creatures breed and deposit eggs. In this aquatic form the species has had several different names. In the case of an evaporating pool, slowly drying away under the summer sun, the larva finds an opportunity along the shallow borders frequently to employ its nostrils at the surface of the water, with the result that the gills become degenerated and transformation is hastened.

Adult specimens secrete themselves in burrows, not far from the vicinity of water, although they may be occasionally found hiding under decaying logs, in very moist situations. They prey upon insects and worms, and they even attack larger creatures, when within reach. A specimen in the writer's collection devoured several very young field mice. Hiding by day, they prowl during the hours of darkness or during rains.

The Four-toed Salamander, *Hemidactylium scutatum* Tschudi (Fig. 5), is small, with cylindrical body and very bluntly oval tail. Color above, deep reddish brown; about the head, especially on the snout, there is a lighter shade, approaching bronze. Close examination of most specimens will reveal the presence of numerous dark spots on the upper surfaces. The sides of the body present a mottled ap-

Four-toed Salamander.

FIG. 5. THE FOUR-TOED SALAMANDER
From specimen in Am. Mus. Nat. Hist.

pearance, and the ground color is much lighter than on the back. The entire under surface is bluish-white, with a few, irregularly placed dark spots, presenting a strong contrast with the principal color.

This small species somewhat approaches the Gray Salamander in appearance, but may be distinguished therefrom by its very blunt snout and proportionately shorter tail. The back and the sides are strongly marked with furrows, a feature in which the species is quite unique. The limbs are small and weak. There are but four toes on the hind foot. Total length, 3 inches; length of tail, 1½ inches.

Range: The entire eastern portion of the United States.

Local Distribution: Mostly along the Palisades of the Hudson River.

The Four-toed Salamander, rather a rare species in this vicinity, is generally found in scattered companies. It is strictly terrestrial, and inhabits timbered regions, where it hides under logs and stones.

FIG. 6. THE GRAY SALAMANDER
From specimen in New York Zoölogical Park

The Gray Salamander, *Plethodon cinereus* Green (Fig. 6), is a small form, very slender and worm-like; tail round and long.

Gray Salamander.

Color above, dark brown, grayish or black, sprinkled with minute silvery spots. Sides of the body lighter and speckled with dark gray. Abdomen pale gray, marbled with a darker shade. Total length, 3 inches. Diameter of body, $\frac{3}{16}$ of an inch.

Range: Southern Canada and the United States generally, east of the Mississippi.

Local Distribution: Particularly abundant on the Palisades of the Hudson River.

This very common little salamander is strictly terrestrial.

It may be found in numbers, hiding under flat stones and logs in damp woods. Although provided with very small and slender limbs, it displays remarkable agility when disturbed, either wriggling its way among fallen leaves, or progressing over them by a series of jumps caused by doubling its worm-like body into a series of lateral undulations and suddenly straightening itself.

The eggs are deposited under damp and decaying logs, in moss or under stones. When the minute larvæ emerge, they possess external gills, but these are absorbed within a few days'

FIG. 7. THE RED-BACKED SALAMANDER
From specimen in New York Zoölogical Park

time. The species is never aquatic at any stage of its life. It is easily distinguished from the other salamanders by its extremely slender body and perfectly round tail.

Red-backed Salamander.

The Red-backed Salamander *Plethodon cinereus erythronotus* Green (Fig. 7), in size and dimensions is like the preceding form. Grayish on the sides with a bright reddish band on the back.

This band is wide, covering the greater portion of the back and extending towards the end of the tail, where it becomes obscure. The lower portions of the sides present a

thickly dotted appearance; the abdomen is grayish, marbled with darker gray. On some specimens the bright band on the back is sprinkled with small gray dots, but these are so minute that they scarcely produce a dull effect upon the color. On occasional specimens these dots fuse together, forming a dull line down the back, and imparting a resemblance to the markings of many specimens of the Two-lined Salamander. From the latter, however, the present species is at once distinguished by its round tail.

Range: The United States east of the Mississippi and southern Canada.

FIG. 8. THE SLIMY SALAMANDER
From specimen in New York Aquarium

Local Distribution: Generally abundant in damp woods.

This variety is commonly found with the typical form, and occasionally under the same logs and stones with the Slimy Salamander.

Slimy Salamander.

The Slimy Salamander, *Plethodon glutinosus* Green (Fig. 8), is of moderate size and rather slender, cylindrical form. The tail is round. Black above, thickly covered with irregular greenish-white, or lichen-gray spots, these often appearing like patches of silvery dust. Different specimens show great variation in the size of the patches, some being blotched with the light color, while others might be said to

be finely speckled therewith. Lead color beneath, on which dull surface many specimens show numerous white dots. This species somewhat resembles the Marbled Salamander, but may be distinguished therefrom by its round tail and more numerous spots. It is, moreover, a more slender creature. The neck is much narrower than the head, causing the latter to look broad and flat, as in the larger salamanders (*Amblystoma*). Total length, 5 inches; length of tail, 2½ inches.

Range: From Canada to Florida and westward to Texas.

Local Distribution: General and common. It is particularly abundant on the New Jersey side of the Hudson River, along the Palisades.

When handled, this salamander exudes through the skin a whitish mucus that adheres persistently, hence the technical name, *glutinosus*, and the common one, Slimy Salamander. It is a common species, preferring hilly or mountainous districts, where it leads an entirely terrestrial life, hiding under stones and logs in thickly timbered places, whence it issues at night or in rainy weather.

Two-lined, or Yellow-backed, Salamander.

The Two-lined, or Yellow-backed, Salamander, *Spelerpes bilineatus* Green (Fig. 9), is a small, slender form, with flat tail. Yellowish on the back, which color is bordered on each side with a band of dark gray, brown or black. These bands start from behind the eye and extend down the tail. Beneath the bands the color is pale yellow, profusely sprinkled with dark spots. The broad, yellowish band, covering the back is often spotted with dark gray or brown, and on some specimens the spots run together down the back forming a narrow, dark line. The entire under surface is bright and immaculate yellow. The body is cylindrical; the tail decidedly compressed. Total length, 3⅝ inches; length of tail, 1⅞ inches; diameter of body, ¼ inch.

Distribution: General, very abundant in the beds of rocky brooks.

Range: From Maine to Florida, and westward to the Missouri River.

The Two-lined Salamander is an extremely active species. It

is usually found hiding under flat stones in the beds of brooks, not actually under water, but where the soil is thoroughly saturated with moisture. When disturbed in its hiding-places, it does not entirely depend upon its diminutive limbs for escaping from danger, but makes surprisingly rapid progress by doubling its body into a series of lateral undulations and suddenly straightening it. The result is a number of bewildering jumps. This performance is varied with a snake-like wriggling. Thus, with a combination of agile motions, the little animal makes like a flash

FIG. 9. THE TWO-LINED OR YELLOW-BACKED SALAMANDER
From specimen in New York Zoölogical Park

for the water and secretes itself among the stones. It is seldom seen except in the immediate vicinity of water, and the larvæ attain nearly the size of the adult before they begin an air-breathing existence.

Long-tailed, or Cave, Salamander.

The Long-tailed, or Cave, Salamander, *Spelerpes longicauda* Green (Fig. 10), resembles in form the Two-lined Salamander, but is a larger species and has a proportionately longer tail. The tail is much compressed and considerably longer than the body. The back is rich yellow, the sides paler. Scattered over the entire upper surface are coarse, black dots, which, on the sides of the tail

usually fuse into a series of upright bands. The abdomen is immaculate yellow. Total length, $4\frac{3}{4}$ inches; length of tail, $2\frac{7}{8}$ inches.

Range: The Central States, and inland portions of the Atlantic States.

Local Distribution: Mr. W. D. W. Miller has captured specimens near Plainfield, New Jersey. The writer has not taken it within the limits embraced by this work, but has found it abundant in Pennsylvania.

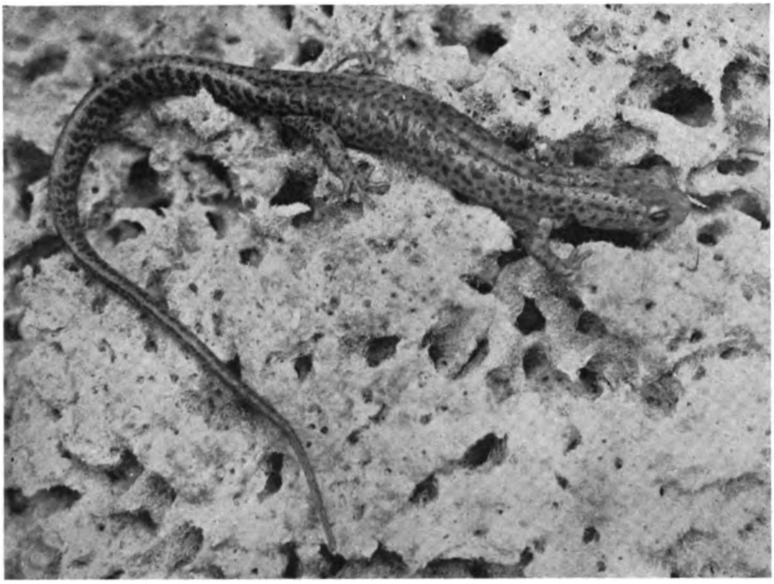


FIG. 10. THE LONG-TAILED, OR CAVE, SALAMANDER
From specimen in Am. Mus. Nat. Hist.

This vividly marked species is at times found at a considerable distance from water, though always in damp situations—in caves or among the fissures of moss-covered rocks. The writer took large numbers of specimens along a mountain stream, at the Delaware Water Gap, Pennsylvania. They were hiding under flat stones in the bed of a nearly dry stream. Their rich coloration was in strong contrast to the damp sand. About a dozen of these specimens lived for a period of more than two years in damp, *sphagnum* moss, placed in an vivarium. During

this period they were supplied with ant-larvæ and white ants, or termites. During the day they always remained hidden, but at night they were frequently observed crawling about the surface of the moss.

Red Salamander.

The Red Salamander, *Spelerpes ruber* Daudin (Fig. 11), is of moderate size. Its form is cylindrical, — slender when young, becoming stout with an increase in length. Limbs small; tail rounded at base and becoming flattened towards the tip. Rich red or salmon color above, profusely sprinkled with small black spots; paler beneath.

FIG. 11. THE RED SALAMANDER
From specimen in New York Zoölogical Park

Young specimens are frequently of a bright coral-red and not distinctly spotted. Those of medium size are darker red, with intensely black spots, while old specimens are often brownish and spotted with gray. Total length of fully adult specimen, 5½ inches; length of tail, 2½ inches; diameter of body, ½ inch.

Range: Canada to the Gulf of Mexico and westward to the Mississippi River.

Local Distribution: Moderately abundant in the Orange Mountains of New Jersey.

The eggs are deposited early in the spring in the deeper pools of brooks; the adults are semi-aquatic, living in the beds of clear and cold brooks under flat stones or in immediate proximity to the water, into which they quickly make their way when disturbed. They may be sometimes found hiding under the luxuriant moss that covers rocks adjacent to mountain streams, where their brilliant color is in vivid contrast to their surroundings.

FIG. 12. THE MOUNTAIN SALAMANDER
From specimen in New York Zoölogical Park

Mountain Salamander.

The Mountain Salamander, *Desmognathus ocrophæa* Cope (Fig. 12), is of moderate size. Body cylindrical; tail rounded for the greater part of its length, flattened near the tip and tapering to a long, sharp point. A wide band of brown extends down the back from behind the head to the base of the tail, where it narrows and becomes indistinct towards the tip. Beneath the brown band the sides are dark gray. From the eye to the angle of the mouth there is a band of light color. The abdomen is dirty white, and generally sprinkled with pure white dots.

On occasional specimens the back is sprinkled with a line of black dots, giving the species a very similar pattern to the Two-

lined Salamander, which it also resembles in outlines. The adult Mountain Salamander may be recognized, however, by its rounded tail. Young specimens strongly resemble the Red-backed Salamander, even to the rounded tail. The following characters should be considered in separating them:

Desmognathus ocrophæa.[1]	*Plethodon cinereus erythronotus.*
Form moderately slender.	Form very slender.
Stripe down the back brownish.	Stripe down the back reddish.
A light band from eye to angle of mouth.	No band from eye to angle of mouth.

Total length, $3\frac{1}{2}$ inches; length of tail, $1\frac{5}{8}$ inches; diameter of body, $\frac{5}{16}$ inch.

Range: Common in the Adirondacks and the mountains of northern Pennsylvania, whence it extends southward into the mountain chains of Virginia and North Carolina.

Local Distribution: Very rare, and the species may possibly not occur within the limits given. A single specimen has been taken at Greenwood Lake, N. J.[2] It has also been found in Allegany County, N. Y. It may occur in the Orange Mountains of New Jersey.

In habits it appears to be quite terrestrial, living under decaying logs or burrowing its way under their bark.

Dusky Salamander.

The Dusky Salamander, *Desmognathus fusca* Rafinesque (Fig. 13), is of medium size. The body is cylindrical and moderately slender; tail flat. Color above dark brown or gray, with an obscure, reddish brown tinge on the back. The reddish brown tone is usually distinct on the tail, where it is paler in hue. Numerous black spots show through the brown of the back, which is often bordered with a tinge approaching pink or flesh color, the pink also showing on the tail. Outside this pinkish shade are numerous minute white dots arranged in thick clusters on the sides of the body. The skin of the abdomen is light and translucent and finely marbled with gray. Very old specimens are generally so dark as to

[1] This species is of doubtful or very rare occurrence in this vicinity.

[2] Taken by Eugene Smith, of Hoboken, N. J.

appear almost uniform black above and show no traces of markings except on the sides and abdomen. The head is about the same width as the body. The front pair of limbs is feeble; the hind pair, larger and stronger. Total length, $4\frac{3}{4}$ inches; length of tail, $2\frac{1}{4}$ inches; diameter of body, $\frac{3}{8}$ inch.

Range: Eastern North America.

Local Distribution: Abundant in the vicinity of small streams.

This is the most abundant of our salamanders, but it is not

FIG. 13. THE DUSKY SALAMANDER
From specimen in New York Zoölogical Park

found except in the immediate vicinity of water. It is common in all situations where flat stones, dead leaves or similar objects not actually in the water, but in damp or muddy places in the beds of pools, offer concealment. When discovered in its lairs it runs and wriggles with bewildering agility, often taking to shallow water and secreting itself in the mud in order to escape. According to Cope, the eggs of this species are connected by an albuminous thread, which contracts and hardens after deposition. One of the sexes protects this string of eggs by twisting it about the body and remaining in concealment. The exact duration of the guard over the progeny is not definitely known. The young

salamanders emerge from the eggs with traces of external gills, which are soon absorbed.

Water Newt.

The Water Newt, *Diemyctylus viridescens* Rafinesque (Fig. 14), is of medium size. The body is rather stout; the tail very flat and fin-like. Dark olive or green above, on which are scattered numerous small black dots; on each side of the back is a row of small round spots of brilliant vermilion or brick red and bordered with narrow rings of black. The abdomen and lower sides of the body are pale yellow, which

FIG. 14. THE WATER NEWT
From specimen in Am. Mus. Nat. Hist.

meets in abrupt contrast the olive of the upper surface; this pale color is thickly covered with small black dots. On the head the line of meeting of the dark and light colors is slightly below the center of the eye.

The tail is very thin and at all times shows traces of fin-like edges, this character being particularly noticeable with the males during the autumn and the spring. Compared with the size of the body the limbs are large and well developed. Male specimens may be distinguished from the females by the large and stocky appearance of the hind limb, the lower joint of which is flattened and very wide, and in appearance quite out of

proportion to the front limb. In female specimens the front and hind limbs are of nearly equal size. During the autumn the males acquire a peculiar series of hard ridges along the inner surface of the hind limbs. This growth is more pronounced during the breeding season when it is clearly discernible as a raised, black process of skin, with a rough surface like the angular edge of a file. Total length, 3⅞ inches; length of tail, 2¼ inches.

Range: Eastern United States and southern Canada.

Local Distribution: General, in ponds and lakes.

In this immediate vicinity, the Water Newt is a strictly aquatic creature, unless, on account of unusual summer heat, the waters of its pond evaporate, when it takes shelter under stones or pieces of bark and in such damp places awaits the refilling of its pond by the fall rains.

The species breeds in the early spring, depositing the eggs singly or in pairs. The eggs are covered with a glutinous envelope and are deposited in such a manner that they adhere to the leaves of aquatic plants. The larvæ possess branching gills like those of the larvæ of the true salamanders. These gills often persist until the animals have reached a length of three inches or more, although absorption usually occurs when the larva is about two inches in length. Thus the transformation appears to be irregular, and not infrequently perfectly developed Water Newts are found that are barely one and one-half inches in length. The metamorphosis is undoubtedly hastened by the warmth of shallow ponds. After the gills have disappeared, the matured individual continues to lead an aquatic life, although if forcibly removed from the water and kept in a damp place, it will live for an indefinite time, breathing with a rapid trembling of the throat, which is the same as the respiratory gulping of the frogs.

Red Eft, or Mountain "Lizard."

The Red Eft, or Mountain "Lizard," *Diemyctylus viridescens miniatus* Raf. (Fig. 15), is a Water Newt which has deserted the ponds in mountainous districts and has taken up life in the damp woods. It is not, however, a distinct variety, since its terrestrial existence is irregular, and it frequently returns to the water to lead an aquatic life. The Red

Eft is merely a phase of the common Newt, but it is an interesting case of adaptation to environment.

Few observers who have visited mountainous places in the eastern United States have failed to notice in the damp woods the brilliant red "lizards" slowly making their way over the carpet of fallen leaves. Among residents of the country places they are known as Red Efts, Fire "Lizards" and Rain "Lizards." These are not lizards, but they are batrachians, and they represent a form of the common Newt that has seemingly tired of the water and begun a terrestrial existence. The animals vary in color from dull brown to brilliant vermilion. Rows of red dots

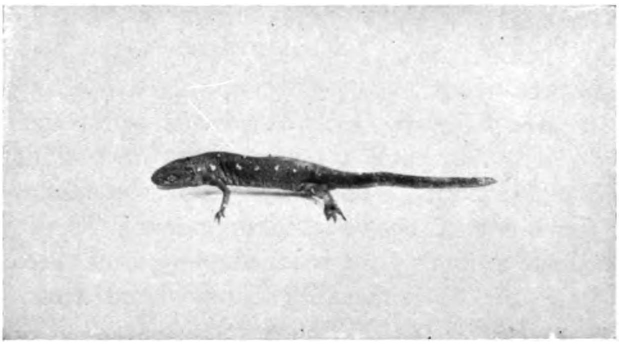


FIG. 15. THE RED EFT, OR MOUNTAIN "LIZARD"
From specimen in New York Zoölogical Park

are very apparent on the brown forms, while on the vermilion forms they are less distinct, but can be discerned as richer red, bordered with narrow circles of black. The brown specimens are forms that have left the water but a short time; those of the brilliant red hues have for some time been leading a terrestrial life. During dry weather the Red Efts hide under leaves and moss; after the summer showers they issue from their hiding-places to swarm through the woods.

In mountain ponds in the heart of districts where the red form is very abundant, the aquatic adults may be found swarming in the water. If the latter are taken from the water and kept in damp moss or among leaves, they lose their greenish tints and the smooth appearance of the skin, becoming dull brown and

rough, an indication of the red hue and rough skin of the terrestrial form. If, on the other hand, specimens found in the woods be placed in an aquarium, they at first show signs of marked distaste for their new quarters. After a time, however, they become reconciled to the water and lose their bright tints, thus beginning to assume the colors of their aquatic associates, while the tail grows broader and better suited for swimming. Very small, bright red forms are often found in the woods, demonstrating that such specimens have left the water immediately after completing the larval stage.

As an explanation of the eccentricities of this species it may be explained that the cool depths of the mountain forests, continuously and heavily shaded, and well saturated with moisture, offer the species an inducement to vary its life history. Close to New York City, where the red form is unknown, the writer has observed an intimation of this terrestrial tendency. In the thick woods of the Palisades of the Hudson, he has found occasional Newts hiding under pieces of bark that rested a few feet from the edge of a pool inhabited by numbers of the kind. Such specimens showed a tinge of brown like the form *miniatus*.

The terrestrial form has been described as possessing a much rougher skin and lacking the fin-folds of the tail of the aquatic form. These characters, however, are caused merely by the drying of the skin.

In the aquarium, the water form is an interesting creature, and may be kept in flourishing condition by feeding it small earthworms or small pieces of raw beef. The red form lives well in a vivarium which has been plentifully supplied with damp moss. It will eat the larvæ of ants and small earthworms. It may be found in the Highlands of the Hudson River. Its range of distribution is much the same as the water form, except that it occurs principally in mountainous districts.

TOADS AND FROGS.

Order *Salientia.*

The Toads and Frogs are the most familiar forms of the batrachians. Eleven species occur in the local fauna, representing four families. All of the local species deposit their eggs in the water and the young pass through a tadpole stage before acquiring the form of the adult. The duration of this larval stage varies considerably with the different species. In some it is limited to a few weeks, others require considerably more than a year to complete their metamorphosis. The growth in the water is much influenced by light and temperature.

For a short time after hatching, the tadpoles of most species are provided on the under surface of the head with two suckers. These organs enable the fragile creatures to cling to the leaves of aquatic plants instead of lying upon the muddy bottom, where they would be exposed to the attacks of many enemies in the shape of the carnivorous larvæ of aquatic insects. At the time of hatching, the young creatures are leech-like in appearance. Development is rapid. Within three days they present the complete form of the tadpole, with fin-like tail. Within a few hours after hatching the mouth-parts begin to develop, and a few days later the little creature feeds upon delicate aquatic vegetation. They then swim readily in search of food, and the suckers become aborted and quickly disappear.

For a few hours after leaving the egg, the frog tadpole possesses branching gills. These soon shrivel and their bases are covered with folds of skin (the "operculum"). Under this fold the fore limbs soon begin their growth. This is the first pair of limbs to acquire full growth, but they are not visible until after the hind pair has appeared. From external appearances the frog tadpole thus seems to acquire the posterior pair of limbs first. Somewhat later the front pair suddenly are thrust through the

folds of the operculum. This is in contrast with the larvæ of the salamanders, in which the operculum is absent and the fore limbs are nearly full grown before the rear pair is visible. Moreover, the tadpoles of the salamanders retain their gill-stalks on each side of the head until after the growth of the limbs is completed.

A popular key to the identification and classification of the Toads and Frogs follows:

Key to the Toads and Frogs.

I. Tips of toes (digits) expanded in the form of adhesive disks or "suckers" . . . . **The Tree Toads.**

a. Size very small.

1. *Disks but slightly developed.*

Brown; a wide green band on the back . . . . **Cricket Frog** (*Acris gryllus crepitans*).

Gray; three brown bands on the back . . . . **Swamp Tree Toad** (*Chorophilus triseriatus*).

2. *Disks well developed.*

Brown to green (varying); a dark, X-shaped mark on the back . . . . **Pickering's Tree Toad** (*Hyla pickeringi*).

b. Size small.

Bright green above, which hue is bordered on sides with a band of white. A purplish band from behind nostril . . . . **Anderson's Tree Toad** (*Hyla andersoni*).

Grayish, with wavy, irregular markings . . . . **Gray Tree Toad** (*Hyla versicolor*).

II. No digital disks. Size moderate to large . . . . **The Toads and Frogs.**

a. Size moderate.

1. Skin thickly studded with wart-like tubercles; a large gland behind the eye . . . . **The Toads.**

Pupil of eye horizontal . . . . **Common Toad** (*Bufo lentiginosus americanus*).

Pupil vertical . . . . **Spade-foot Toad** (*Scaphiopus holbrooki*).

2. Skin smooth; no gland behind eye .... **The Frogs.**

2a. A vein-like fold of skin from behind eye to the groin.

Pale brown; a dark-brown blotch behind the eye .... **Wood Frog** (*Rana sylvatica*).

Olive, with large, round, black spots, irregularly scattered... **Salt-marsh Frog** (*Rana virescens*).

Pale brown, with four rows of large black spots .... **Leopard Frog** (*Rana palustris*).

Green or olive; head paler..... **Pond Frog** (*Rana clamitans*).

2b. No vein-like fold of skin.

b. Size large.

Olive, irregularly mottled with brown .... **Bull Frog** (*Rana catesbiana*).

Descriptive List of the Toads and Frogs.

Common Toad.

The Common Toad, *Bufo lentiginosus americanus* Le Conte (Fig. 16), is of moderate size and stout form. The skin is very rough. A large and prominent gland exists behind the eye. Color above brownish or yellowish brown, with numerous large dark spots, narrowly, though distinctly, edged with pale yellow. Extending down the center of the back is a pale yellowish or whitish band. The abdomen is dirty white. The ground color varies in individuals, some being distinctly reddish, and is influenced by temperature and changes on the individual itself from a lighter to a darker shade or the reverse. The pupil of the eye is horizontal.

The Toad is a familiar creature and is quite characteristic in appearance on account of its very rough glandular skin and the large, swollen glands behind the eyes. The hind feet are but slightly webbed. The blackish hue of the skin under the throat of the male Toad distinguishes it from the female. This skin is capable of great extension as the creature gives voice to the peculiar cry of the breeding season. The females are larger than the males. Length of body of male specimen, $2\frac{3}{8}$ inches; of female, $2\frac{3}{4}$ inches.

Range: Four varieties of this species inhabit North America. One of these appears to occur only in northeastern Massachusetts; another is confined to the Rocky Mountain region; the typical form is found in the southeastern United States, while the variety that occurs locally is distributed over an extensive area, namely: from British America to the Southern States and westward to Arizona.

Local Distribution: Common and abundant.

There is but one species of the local batrachians which

FIG. 16. THE COMMON TOAD
From specimen in Am. Mus. Nat. Hist.

might be confused by the observer with the Common Toad, and that is the Spadefoot Toad. The Spadefoot Toad receives its name from a pronounced spade-like process on the inner edge of the hind foot, a feature which is also slightly developed on the common species. The color of the Spadefoot is, however, quite different from the ordinary toad. Instead of the single light band along the back of the Common Toad, the Spadefoot has two pale bands, which run together and fork at the end of the body.

Many of the reptiles and batrachians have habits which render them of considerable economic value to the agriculturist,

but the Toad ranks first in the list of useful species. Although mainly insectivorous, the depredation on insect life made by the frogs is chiefly confined to the borders of ponds and streams, or to the marshes; in fact, to places not available for agriculture. The Toad, on the contrary, is a terrestrial species, inhabiting the open country and abounding over stretches of farmland. Here at twilight multitudes of toads issue forth to prey upon all forms of insect life, continuing the hunt throughout the night, and retiring at dawn for digestion. The examination of a toad's stomach after a nocturnal excursion will reveal an amazing number of insect forms, among which may always be found species that are destructive to agricultural products.

Among the writings of Shakespeare there are allusions to the venomous character of the Toad which have inspired innumerable scientists to clash in argument. Comparatively recent anatomical investigations have resulted in the discovery that a milky secretion contained in the swollen glands situated behind the eyes and in minute glands scattered over the surface of the skin possesses decidedly poisonous properties. When this fluid is injected into the blood of small mammals, marked symptoms at once develop and speedy death follows. The symptoms produced have been described as similar to those due to the use of *digitalis*, the action being upon the nerve centers and the heart. The effect upon any unwary dog that seizes a toad in its jaws is at once evident. There are immediate signs of distress, and the animal soon foams at the mouth and champs its jaws as if in considerable pain. These symptoms continue for an hour or more.

When the larger glands on the head are compressed, tiny jets of a sticky white fluid are ejected to a distance of three or four inches. Through accident the writer has discovered that this fluid is intensely bitter to the taste. In spite of this poisonous secretion, the Toad is generally harmless when handled. The story of wart-producing powers, furthermore, is purely fallacious. The secretion in the glands which have been mentioned is dangerous only when injected directly into the blood of small animals, but nevertheless Shakespeare's much-combated references have been proved to have abundant foundation in fact.

Most batrachians, particularly those species with a rough skin, secrete a certain amount of this irritant.[1]

The Toad is protected by the characters just mentioned from attack by most mammals and birds. The species of snakes, however, that prey upon cold-blooded creatures, appear to prefer toads to frogs.

In its metamorphosis the Toad differs somewhat from the frogs. It leaves its place of hibernation rather late, not until warm weather has become established in the spring, when the weird, drawn-out trill of the males is heard about rain pools and shallow bodies of still water. The eggs are deposited in long strings.[2] After the strings have absorbed the required amount of water through their transparent covering and lie upon the bottom undergoing development. Each egg measures about a quarter of an inch in diameter. The tadpoles emerge from the eggs after a period of eight to ten days from deposition. They resemble minute leeches and cling for some hours to the leaves of aquatic plants by means of small suckers on the lower surface of the head. Within forty-eight hours they cease the clinging stage and wriggle their way about by means of a rapidly developing, fin-like tail. Four days after hatching they are agile swimmers and feed upon mossy growths of the pool.

The writer has made the following observations upon growth during the tadpole stage:

May	3.	Tadpoles hatched. Clinging stage.....	Length,	$\frac{1}{8}$	inch
"	4.	Body more elongate; swimming feebly at frequent intervals...............	"	$\frac{3}{16}$	"
"	5.	Tail distinctly compressed............	"	$\frac{1}{4}$	"
"	6.	Tail shows fin-like edges..............	"	$\frac{9}{32}$	"
"	7.	Tail fully developed; feeding..........	"	$\frac{5}{16}$	"
"	12.	Body assuming stout proportions......	"	$\frac{1}{2}$	"
"	17.	Color above jet black.................	"	$\frac{3}{4}$	"
"	25.	Tadpoles appear fully grown and cluster in masses in very shallow places......	"	$1\frac{1}{16}$	inches

[1] Among the local frogs the character named is strongly evidenced by the Leopard Frog (*Rana palustris*). When handled, this species gives out a strong odor. Few snakes will eat it.

[2] The eggs of the frogs are deposited in masses.

May	26.	Rudiments of hind limbs discernible.	
"	30.	Hind limbs perfectly formed in miniature and measure $\frac{3}{16}$ inch in length. The tadpoles are now brownish and show traces of spots...............	Length $1\frac{5}{32}$ inches
June	4.	Hind limbs $\frac{3}{8}$ inch long.	
"	5.	" " $\frac{7}{16}$ " "	
"	12.	" " fully developed...........	" $1\frac{1}{4}$ "
"	14.	Front limbs break through operculum.	
"	16.	Absorption of tail rapidly taking place.	
"	18.	Tail nearly absorbed; young toads leaving the water.	
"	20.	Metamorphosis complete; surrounding meadows teeming with perfectly developed toads measuring $\frac{7}{16}$ inch (body).	

The full-grown tadpole of the Toad and the perfectly developed creature as it leaves the water, are much smaller than the frog tadpole, which usually attains a length of three and one quarter inches before growth of the hind limbs begins, while the perfect frog generally measures an inch or more when it becomes fitted for semi-aquatic life. The tiny toads fall a prey to many enemies, and but a small proportion of their numbers attains maturity. Full growth is reached in about three years.

Spadefoot Toad.

The Spadefoot Toad, *Scaphiopus holbrooki* Harlan (Fig. 17), is moderate in size. In form it is very stout, with wide, blunt head. Color, dark brown, or ashy-brown, with two rather indistinct bands of paler shade on the back; these bands begin behind the eyes and extend in wavy or irregular fashion to the end of the body, where they run together.

Although the skin is rough and is covered with numerous raised points, it presents a smoother surface than that of the Common Toad. The parotid gland (behind the eye), though well-developed and very pronounced, is of smaller size in proportion to the individual than that of the Common Toad.

On the inner portion of the under surface of the hind foot there is a hard, spade-like process, tinged at the edge with deep black. From this appendage the creature derives its name. The hind foot is fully webbed. The pupil of the eye is elliptical

(cat-like), a characteristic which is useful in distinguishing this species from the Common Toad, since in the latter the pupil is horizontal.

The species presents some variation in color pattern. Specimens from the northern portions of the United States are sometimes nearly uniform in color, while those from the extreme South possess a very distinct pattern. Length of body, in sitting posture, 2⅛ inches; total length, hind limbs outstretched, 5 inches; width of head over ear plates 1⅛ inches.

Range: The entire eastern United States, from New England to Florida and westward to Texas.

FIG. 17. THE SPADEFOOT TOAD
From specimen in New York Zoölogical Park

Local Distribution: Rare.

The retiring habits of the Spadefoot Toad render it an object seldom seen. The animal employs the sharp scoops of its hind feet to work its way into the soft ground or sand, and there passes the hours of daylight entirely hidden. At night or after heavy showers it ventures abroad for food, sometimes lingering in the vicinity of a rain-pool and uttering its plaintive cry. During the latter part of April and in May this toad congregates in numbers about shallow bodies of water to breed. The voice of the male resembles the tremulous call of the Common Toad, but is slightly louder. The eggs are similar to those of the Toad, and are laid in strings. The metamorphosis is completed within a few weeks from the time of hatching.

The Cricket Frog, *Acris gryllus crepitans* Baird (Fig. 18), is very small. The skin is rough. The body color is brown or grayish brown. Extending from the snout nearly to the end of the body there is a wide band of bright green, which is interrupted between the eyes by a dark triangular blotch, with its point directed backwards. There are three small blotches on the sides, while the hind limbs are banded with dark brown. Beneath, the color is yellowish white.

Cricket Frog.

This species is subject to rapid and marked color changes

FIG. 18. THE CRICKET FROG
From specimen in New York Zoölogical Park

under the influence of varying temperature and the mood of the individual. These changes affect the general color of the body and the bright band down the back. The band, although usually of some shade of green, sometimes fades to yellowish brown. The species is easily distinguished on account of its distinct color pattern. It is the smallest of the local, tailless batrachians. Length of body, $\frac{7}{8}$ inch; total length with hind limbs outstretched, $2\frac{1}{4}$ inches.

Range: The typical form occurs from North Carolina to Florida, and westward to Louisiana. The variety *crepitans*, also, is found from the southern portion of New York State to North Carolina; it extends westward to Kansas, and still farther westward in the extreme northern portion of its range.

Local Distribution: The local form, var. *crepitans*, is common in portions of Long Island and in New Jersey.

The Cricket Frog frequents the borders of shallow pools, where its sharp, trilling cry, resembling in volume the call of the field cricket, may be heard at various times of the year. It is particularly vociferous during the breeding season. The eggs are deposited early in May in small bunches. They usually adhere to grass or reeds.

The animal is very difficult to capture, since it possesses

FIG. 19. SWAMP TREE TOAD
From specimen in Am. Mus. Nat. Hist.

great leaping powers and quickness in diving. During periods of heavy dew these frogs may be found in high grass adjacent to marshes. Owing to its smallness and agility, it is rarely observed after the breeding season.

Swamp Tree Toad.

The Swamp Tree Toad, *Chorophilus triseriatus* Wied. (Fig. 19), although a very small species, is larger than the Cricket Frog. It may be readily recognized by the coloration. The ground color is pale gray. On the back are three dark brown stripes or bands, extending the length of the body. On the side is a broader band, extending from the snout

across the eye and thence along the greater length of the body. The abdomen is whitish, with a few scattered black dots. Length of body, $1\frac{1}{16}$ inches; total length, with hind limbs outstretched, $2\frac{1}{4}$ inches.

Range: This is essentially a western species. It is very abundant in the northwestern portion of the United States, east of the Rocky Mountains, whence it extends southward into Texas. The range extends eastward in the shape of a narrowing band which terminates in central and southern New Jersey. In this apex of its eastern distribution the species is common, especially in the swampy areas of the barrens of the southwestern part of the State.

Local Distribution: Mr. W. D. W. Miller has taken many specimens near Plainfield, N. J.

Like other species of the *Hylidæ*, this creature leaves its winter quarters early and gathers about shallow pools and ditches to breed. It is not an agile swimmer, since the hind feet are not webbed. If alarmed when near the water, it wriggles its way into the marginal vegetation so quickly that it is difficult to capture. Its cry is a sharp trill like that of the Cricket Frog.

Pickering's Tree Toad.

Pickering's Tree Toad, or "Peeper," *Hyla pickeringi* Storer (Fig. 20), is a very small animal. The body is pale brown above with distinct, narrow markings on the back which assume the form of an X on the upper portion of the back, behind which is a Λ-shaped marking. At the end of the body there is another mark, similar to the latter, but of about half the size. A similar mark with the point directed backwards occurs behind the eyes. A band of the same dark color that constitutes the markings on the back extends from the snout across the eye, and thence down the side to a short distance behind the fore limb. The hind limbs are banded. Beneath, the color is yellowish white.

Although the color-pattern is generally pronounced, and the usual colors of the species are as described, this individual varies greatly in color, not only in different individuals but also in the same individual at different times. The writer has observed specimens of normal colors change to pale gray, and

others to a bright tint of green. While the animal was in the green phase, the pattern on the back could not be discerned.

The toes are provided with well-developed adhesive disks, or "suckers," which are particularly distinct on the fore feet. The skin of the abdomen is coarse and granulated; that of the back is smooth.

Male specimens of this species may be distinguished from the females by the loose, dark skin on the throat. This loose skin constitutes the vocal sac, an organ capable of great ex-

FIG. 20. PICKERING'S TREE TOAD
From specimen in New York Zoölogical Park

pansion while the animal is uttering its shrill mating call. Length of body, $1\frac{1}{8}$ inches; total length, hind limbs outstretched, $2\frac{1}{2}$ inches.

Range: The entire eastern and central portions of the United States, abundant.

Local Distribution: Common, but not easily seen.

Only three representatives of the genus *Hyla* are found in this vicinity.[1] The species are easily distinguished from one another by their characteristic color-patterns, and from other tailless batrachians by their peculiar feet and the disks on the toes.

[1] One species, the *Hyla andersoni*, is of doubtful occurrence, although it is included in this Leaflet.

With the first mild days of spring, the bogs and marshes resound with the cheery, piping notes of the males of this species, the peculiar character of which has given rise to the popular name of "Peeper." Specimens are difficult to find, since they hide among the blades of the coarse grass, and when disturbed take refuge in the water. After the breeding season the animals

Miss Mary Dickerson, Photo.

FIG. 21. ANDERSON'S TREE TOAD

leave the bogs and live among the leaves and low bushes and rank vegetation, and their sharp cries are seldom heard. To produce the piping cry, so intense and penetrating for so small a creature, the male fills his vocal sac with air until it is more than half the size of the body. Then the air is expelled with such energy that the sides of the tiny creature become hollow with the convulsive effort. The eggs of this species are deposited in small masses and hatch quickly. The tadpoles undergo a rapid metamorphosis.

Anderson's Tree Toad, *Hyla andersoni* Baird (Fig. 21), is of moderate size. The disks on the toes are well developed. Bright pea-green above with a narrow, though very distinct, white border on the sides and upper surfaces of the limbs. A narrow, purplish brown band extends from behind each nostril, across the eye and to the base of the fore limb. The lower sides are purplish brown, though of a lighter shade than the band, and are ornamented with irregular spots of a lighter and richer hue. The abdomen is pinkish white, though its edges are suffused with the purple tinge of the sides.

Anderson's Tree Toad.

This species is of great rarity, and but very few specimens have ever been captured. It is a most attractively colored creature, and on account of the pale green of the upper surface resembles the European Tree Toad. Mature specimens are from an inch and a quarter to an inch and a half in length.

Range: The species is so rare that its range has not yet been determined, but is supposed to extend from southern New York to Florida. The species has been found in South Carolina.

Local Distribution: One specimen has been taken at Jackson, N. J., another at May's Landing and still another (represented in the figure) at Lakehurst, in the same State.

The Gray Tree Toad, *Hyla versicolor* Le Conte (Figs. 22 and 28), is of moderate size and stout form. The ends of the toes are disk-like and adhesive. Color above, usually pale lichen-gray, with large wavy and irregular markings of darker shade. On the hind limbs these darker markings are so disposed that they appear to form two bands when the limbs are folded. Abdomen uniform grayish white; lower portion of hind limbs tinged with bright yellow.

Gray Tree Toad.

The skin is very rough and is covered with minute, warty points on the back. Male specimens differ from the females in having loose, dark skin under the throat.

The species exhibits great variation in color according to light, temperature and the temperament of the individual. From the pale, ashy gray ordinarily present, the color varies to brown, very dark gray, or to vivid green. With the variation

of color the pattern becomes obscure or more prominent. Length of body, 2 inches; total length with hind limbs outstretched, $4\frac{5}{8}$ inches.

Range: The entire eastern and central portions of the United States, from Maine to Florida, and westward to Texas.

Local Distribution: General and fairly abundant.

The call of the Gray Tree Toad is a loud clattering sound, and resembles the scolding of a frightened chipmunk or red squirrel. It is said that the Tree Toad is particularly vociferous before a coming rain. Like other prognosticators of the weather, however, these creatures are quite unreliable. Their cries are

FIG. 22. THE GRAY TREE TOAD
From specimen in New York Zoölogical Park

particularly frequent during the sultry intervals that follow a light summer shower. After the breeding season is over, this Tree Toad frequents trees and usually takes up its abode at some elevation above the ground. It is supposed to deposit its eggs during the latter part of May or early in June. Small weedy ponds are usually selected as breeding-places. The eggs hatch quickly and the transformation from the tadpole stage is rapid.

Salt-Marsh Frog.

The Salt-Marsh Frog, *Rana virescens* Kalm (Fig. 23), is of moderate size and rather slender form. Ground color bronze to olive or bright green, but always vividly marked with large and irregularly scattered round spots of dark brown or black; on the back several of these spots are very elongate. The spots are more regularly disposed on the hind limbs, and when the legs are flexed, they have a banded

appearance. Over each eye there is a rounded spot, placed slightly inwards towards the center of the head.

A raised, vein-like fold of skin extends from behind each eye to the end of the body and is pale bronze in color. A stripe of similar color extends on each side of the head from the tip of the snout to behind the earplate, where it terminates in a raised skin fold. The under parts are white, indistinctly mottled with gray about the limbs.

When examined from directly above, the arrangement of the spots on the back appears to be irregular. This character may be employed to distinguish the species from the Leopard Frog,

FIG. 23. THE SALT-MARSH FROG
From specimen in New York Zoölogical Park

which it resembles in form and pattern. On the Leopard Frog the spots are rather square in shape and are quite regularly disposed in rows down the back and the sides. Length of body, 3½ inches; total length, hind limbs outstretched, 9 inches. These measurements were taken from a very large specimen. The average length of body is about 2¾ inches, and total length more than 7 inches.

Range: Maine to Texas. Several varieties of the species are recognized, some of which occur in the Western States, Mexico and Central America.

Local Distribution: Abundant in swampy situations near the coast.

The Salt-Marsh Frog, sometimes called the Field Frog, inhabits swampy meadows rather than large bodies of water, and is common in many brackish swamps in this vicinity, although it is also found in fresh-water swamps. It is particularly abundant in the Newark meadows. The vocal sacs of the males are

FIG. 24. THE LEOPARD FROG, OR PICKEREL FROG
From specimen in Am. Mus. Nat. Hist.

very prominent externally and become distended as the species gives voice to its sharp, rasping call.

Leopard, or Pickerel, Frog.

The Leopard Frog, or Pickerel Frog, *Rana palustris* Le Conte (Fig. 24), is of moderate size and rather slender form. Ground color above, pale brown, with four rows of large square spots, two rows down the back and one on each side. These spots are very dark brown or black. The hind limbs are banded with the same color, which is also present in irregular spots on the fore limbs. There is a large spot over each eye, and one directly over the snout. The upper lips are dark brown, and above this color there is a band of pale bronze.

Four ridges or elevated folds of the skin extend down the back, the two outer rows of which are vividly tinged with light bronze; the two inner folds traverse the centers of the rows of dark spots on the back. The abdomen is silvery white. The under surface of the hind limbs is bright yellow, as is also a small area behind each fore limb.

The species may be distinguished from the Salt-Marsh Frog by the regularity of the rows of spots. It is the most showy of our local frogs.

Range: Eastern North America.

Local Distribution: General.

The Leopard Frog is a wanderer, traversing and frequenting stretches of damp meadows and fresh-water swamps. It is sometimes found a considerable distance from the water. Young specimens are most numerous about shallow, slow-running streams bordered with dense vegetation.

When in danger this frog exudes through its skin an acrid secretion which protects the creature from its enemies. Few snakes eat these frogs. They are said, however, to be good bait for pickerel on account of their bright colors; hence one of the popular names, the "Pickerel Frog."

Pond, or Green, Frog.

The Pond Frog, or Green Frog, *Rana clamata* Daubin (Fig. 25), is a large species. Form, stout. Dark brown or olive-green above, with an irregular sprinkling of darker spots; head usually bright green. White beneath, with an obscure marbling of gray about the under surface of the limbs; throat of the male generally yellow; of the female, white, marbled with gray.

The color of the individual varies with the changes in light and temperature. A common phase displays much vivid green about the head and anterior portion of the body, while the posterior portion is brown or olive. Sometimes the entire body is green, in other instances dull brown. The male may be distinguished from the female by his much larger earplate (tympanum).

This species resembles the Bull Frog, but may be readily distinguished therefrom by a marked anatomical character: on each side, beginning behind the eye and extending nearly the

entire length of the body, there is a vein-like ridge or fold of skin. The Pond Frog is, moreover, considerably smaller. Average length of body, 3½ inches; total length, with limbs outstretched, 7¾ inches.

Range: Eastern and central United States and southern Canada.

Local Distribution: General and abundant.

With the possible exception of the Toad, the Pond Frog is the most familiar of our local batrachians. It is found everywhere and abundantly in ponds and streams, where its familiar

FIG. 25. THE POND FROG, OR GREEN FROG
From specimen in Am. Mus. Nat. Hist.

croaking may be heard during the summer months. The eggs are deposited in masses early in the spring. The jelly-like clusters containing the numerous black dots representing the developing embryos are familiar objects. The tadpoles are rather slow in growth, generally consuming two seasons before they complete their metamorphosis, according to the temperature of the water and its exposure to sunlight. In the fall the tadpoles burrow into the mud and hibernate. The average tadpole is three inches in length when the limbs are well advanced in growth, and the young frog, immediately after absorption of the tail, measures slightly more than an inch. Tadpoles

confined in indoor aquaria are much retarded in their growth, and many remain as such for a period of three years or more.

Bull Frog.

The Bull Frog, *Rana catesbiana* Shaw (Fig. 26), is very large and stout. Limbs short but powerful. Hind feet large and very fully webbed. Head wide. Color above, light olive, irregularly blotched or marbled with dark olive or brown. The intensity of these markings varies with individuals and the disposition of the individuals themselves. Limbs, especially the hind pair, with brown blotches which to-

FIG. 26. THE BULL FROG
From specimen in New York Zoölogical Park

ward the extremities assume the form of bands. The under parts are silvery white, with grayish markings, the throat in many individuals assuming a yellowish tinge. The portion of the head between the mouth and the eyes is usually tinged with pale green; the upper surface, however, matches the general color of the body.

Half-grown specimens resemble the adult of the Pond Frog, but may be recognized by the absence of the vein-like fold of

skin which is present on each side of the body in that species. There is, in fact, no trace of this in the Bull Frog. A full-grown specimen will measure 14½ inches from the tip of the snout to the end of the outstretched limbs, and 6¾ inches when in a sitting position. Such a specimen would weigh about one pound.

Range: The eastern and central portions of the United States and southern Canada.

Local Distribution: General, but not so abundant as the Pond Frog.

The Bull Frog frequents larger bodies of water than the common Pond Frog, being especially partial to large ponds and slow-running rivers, where the banks are lined with overhanging vegetation in which it can find concealment. The tadpoles grow to a greater size than those of the Common Frog. They may be distinguished by their distinctly yellowish abdomen. During the hours of sunlight they have a habit of lying in shallows around the borders of the pond, but upon the slightest disturbance they scurry for deeper water with startling activity and swim close to the bottom in order to leave a trail of muddy water, agitated by the thrashing of their tails. This maneuver tends to conceal their exact location.

Bull Frogs, particularly young specimens, have a peculiar habit of emitting a sharp cry when disturbed on the bank, and instead of plunging directly into the water, they skim over the surface for a short distance. The Common Frog, on the other hand, when disturbed, jumps into the water and instantly dives to the bottom, where, with a quick kicking of the hind limbs, it stirs up a cloud of mud in which it can conceal itself.

The Bull Frog is a most voracious creature. Mature specimens do not hesitate to swallow any moving object of about their own size that may come within reach of the wide gape of their jaws. They are largely insectivorous, but birds and small rodents are frequently eaten. Captive specimens experience no difficulty in swallowing sparrows or half-grown rats.

The call of a Bull Frog differs from the ordinary "croak" of a Pond Frog. It is a deep, protracted bass, resembling the sound made by drawing a bow for half its length across the string of a bass-viol. The note is repeated four to six times.

The eggs of the Bull Frog are laid in May. During the latter part of July or in August of their second summer the tadpoles acquire limbs and leave the water as perfect frogs.

Wood Frog.

The Wood Frog, *Rana sylvatica* Le Conte (Fig. 27), is of small size. It is light brown above, with a dark brown spot on each side of the head. This spot extends from the snout through the eye (darkening the lower half of the iris), covers the earplate and adjacent area and terminates in a sharp angular outline with a fold of the skin behind

FIG. 27. THE WOOD FROG
From specimen in New York Zoölogical Park

the base of the fore limb. A whitish line in strong contrast with the dark color on the sides of the snout traverses the upper lip. There is a smaller dark spot near the base of the fore limb. The hind limbs are indistinctly banded on the upper surface. The abdomen is silvery white.

Two well-defined ridges, or vein-like folds, extend down the back of this easily-recognizable species. In different specimens the body color varies somewhat, some are distinctly reddish. The characteristic dark spot on each side of the head is always apparent, however, and facilitates identification. Length of body, 2¼ inches; total length, with hind limbs outstretched, 5¾ inches.

Range: Like many of the North American frogs, it is gener-

ally distributed over the eastern and central portions of the United States and southern Canada. It does not extend, however, into the sandy portions of the Southern States.

Local Distribution: The Wood Frog appears to be restricted to certain areas, in which it is abundant. The writer has found it common in the woods along the Palisades of the Hudson River and in Westchester County, N. Y.

The Wood Frog, even where it is abundant, is not often seen, on account of its habit of living among the fallen leaves of timbered districts and the fact that its sober colors almost precisely match the dead leaves. It is aquatic only in the spring, when it frequents small bodies of water for the purpose of laying its eggs. At such times the croaking of the many males indicate the first awakening of the cold-blooded creatures from their winter sleep, for the Wood Frog lays its eggs before the ice has entirely left the ponds. The writer has repeatedly observed them as early as March. The eggs are deposited in masses from two to three inches in diameter, and hatch within ten days. The tadpoles grow rapidly and, unless their pool receives the water from cold springs, complete their transformation early in the summer. They are black above and bright golden bronze beneath. Upon leaving the water the young frog is slightly more than half an inch in length.

FIG. 28. THE GRAY TREE TOAD
From specimen in New York Zoölogical Park

Guide Leaflets.

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No. 1. **THE BIRD ROCK GROUP.** By FRANK M. CHAPMAN, Associate Curator of Mammalogy and Ornithology. October, 1901. *Price, 10 cents.*

No. 2. **THE SAGINAW VALLEY COLLECTION.** By HARLAN I. SMITH, Assistant Curator of Archæology. December, 1901. *Price, 10 cents.*

No. 3. **THE HALL OF FOSSIL VERTEBRATES.** By W. D. MATTHEW, Ph.D., Assist. Curator, Vertebrate Palæontology. January, 1902. *Out of Print.*

No. 4. **THE COLLECTION OF MINERALS.** By LOUIS P. GRATACAP, A.M., Curator of Mineralogy. Feb., 1902. *Rev. ed., May, 1904. Price, 10 cents.*

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THE AMERICAN MUSEUM JOURNAL

VOLUME VI, 1906

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1906

The American Museum of Natural History

77TH STREET AND CENTRAL PARK WEST, NEW YORK

Scientific Staff

ERRATA.

The Editor regrets the occurrence of the following errors in the Guide to the Local Collection of Birds, which of necessity was printed in the absence of the author:

Page	85,	line	39	for Woodcocks	read Woodcock.
"	88,	"	7	" Black Gyrfalcon ?	read Gyrfalcon.
"	90,	"	6	" White Gyrfalcon	" Black Gyrfalcon.
"	138,	"	5	" *Iherminieri*	" *l'herminieri.*
"	143,	"	1	" *albiferons*	" *albifrons.*
"	143,	"	28	" *Gura*	" *Guara.*
"	145,	"	1	" *Colurnicops*	" *Coturnicops.*
"	145,	"	5,	omit "See group, third floor."	
"	149,	"	37	for Kildeer	read Killdeer.
"	150,	"	14	" *pallitus*	" *palliatus.*
"	152,	"	14	" Swaison's	" Swainson's.
"	152,	"	27	" *Haliætus*	" *Haliæetus.*
"	159.	"	21	" Family ALCEDINIDÆ. Kingfishers	read — Family PICIDÆ. Woodpeckers.
"	175,	"	11	for *Progue*	read *Progne.*
"	179,	"	40	" *domina*	" *dominica.*
"	183,	"	11	" *Opornis*	" *Oporornis.*
"	184,	"	11	" *Steophaga*	" *Setophaga.*
"	187,	"	25	" *mustclina*	" *mustelina.*
"	188,	"	8	" *Hylocichla bicknelli*	read *Hylocichla aliciæ bicknelli.*

Prefix the asterisk [*], indicating occurrence in Central Park, to the following species:

Screech Owl,	Gray-cheeked Thrush,
Northern Water-Thrush,	Olive-backed Thrush,
Louisiana Water-Thrush,	Hermit Thrush,
Yellow-breasted Chat,	American Robin,
Wilson's Thrush,	Bluebird.

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2 Naturally Mummified Body found in a copper mine at Chuquicamata, Chile.

The American Museum Journal

VOL. VI. JANUARY, 1906. No. 1

THE chief feature of the current number of the JOURNAL is an article by Dr. B. E. Dahlgren, of the scientific staff of the Museum, describing the development of a mollusk and forming a guide to the series of models which he has prepared to illustrate the development from the egg to the adult stage of the little shell known to the conchologist as *Crepidula*. This shell occurs in great numbers along the North Atlantic coast and is commonly known in the United States as the "Boat Shell," on account of its shape and the diaphragm in it which resembles the thwart of a boat. In Great Britain the same shell is called the "Slipper Limpet." This article is also published separately as No. 21 of the Museum series of Guide Leaflets and may be obtained at a nominal price.

A NATURALLY MUMMIFIED BODY FROM CHILE.

ONE of the most remarkable specimens that the Department of Ethnology has acquired in years was obtained by the Museum in November. It is a naturally mummified body which was found in a copper mine at Chuquicamata, province of Antofagasta, Chile. The condition of the body shows that the unfortunate miner, probably a woman, was caught by a cave-in of the roof and partly crushed. The mummification seems to have been produced in part by the action of copper salts and not to have been merely a desiccation due to the dryness of the region. The skin has not collapsed on the bones, as in the mummies found usually in the region, but the body and limbs preserve nearly their natural size and proportions, except for the crushing already mentioned. No analysis has yet been made of the tissues, so that it is too early to hazard any supposition as to

the chemical changes which have been undergone. The mine has been worked for an unknown length of time upon a peculiar deposit of atacamite, a hydrous chloride of copper, which is much prized on account of its easy reduction. The age of the mummy is unknown, but it is supposed to be pre-Columbian.

THE SERIES OF ETHNOLOGICAL BUSTS.

THE model of the bust, or rather the head and neck, of the young Filipino, illustrated on page 5, is one of an extensive series of typical portrait busts which the Museum has been assembling during the past eight years. The basis of the model is a mold, or mask, of the face taken from a living subject. The Museum now has more than five hundred such molds, together with the additional data necessary for producing the busts. A large number of complete busts has already been prepared. They are in use for study and for exhibition in the Museum and are in constant demand for exchange with other institutions.

The greater part of the molds represent typical individuals of the North American tribes: the Indians of the Eastern Woodlands, the Plains and Pueblo districts, California, the Pacific Coast and the Eskimo of the Arctic regions. Of Asiatic peoples the Aino, Chinese, Japanese and several Siberian tribes are well represented. Molds from the Philippine, African and South American native tribes who were at the St. Louis exposition are recent additions to the series.

It is the purpose of the Department of Ethnology to make a collection in which all the physical types of man shall be represented For many years the value of a collection of skulls from the different races has been appreciated, but the experience of investigators is that skulls alone give inadequate data for the study of a race, since differences in the form and size of the skull are not correlated with variations in the size and form of the head. The ideal method of studying the facial characteristics of a race is by means of direct measurement of living subjects. Since, however, such subjects are not always available, and an

CLAY BUST OF FILIPINO YOUTH

Modeled at the American Museum of Natural History by Caspar Mayer.

opportunity for repeating measurements is not often offered, properly prepared molds of faces provide the ethnologist with a reliable record upon which to base his investigations.

The task of making the molds from life and preparing the modeled busts for the Museum series was placed in the hands of Mr. Caspar Mayer, under the direction of the curators of the Department of Ethnology Mr. Mayer has greatly improved the old methods and has devised new processes for taking life-masks and utilizing them in connection with photographs and measurements for the rapid production of busts which represent with reasonable accuracy the individuals treated.

THE COLLECTIONS ILLUSTRATING THE ROCKS AND MINERALS OF MANHATTAN ISLAND.

THOSE who are interested in local geology and mineralogy will find much to repay careful study in two collections which are on exhibition in the Museum : the rocks of Manhattan Island at the north end of the Hall of Geology, and the loan collection of the New York Mineralogical Club, comprising an almost complete series of the minerals of the island, which is on exhibition in Case 27 in the Morgan Mineral Hall. In addition to the collections on exhibition, there is a large study collection of the rocks which were encountered in the excavation of the Subway.

The foundation of Manhattan Island consists entirely of crystalline rocks: gneiss, mica, schist, hornblende schist, serpentine and magnesian limestone (dolomite). Cutting through the gneiss and schist there are countless veins and dikes of granite and pegmatite, and these have supplied most of the minerals for which the island is noted. The crystalline rocks have been covered with a mantle of Glacial Drift (unstratified gravel, sand and clay) of varying thickness, while below Fourteenth Street there are extensive river deposits of stratified gravel, sand and clay among bosses of rock (schist) most of which were below the ancient water-level.

The major portion of the island consists of the gneiss and

schists, the general trend ("strike") of which is N.N.E.-S.S.W. These rocks can be studied in almost every excavation for building purposes, and there are numerous excellent exposures of them, which fortunately will never be covered, in Central, Riverside and Morningside Parks and along the Speedway and

MICACEOUS GNEISS

A block of Fordham Gneiss (Archæan) from the east end of Washington Bridge, N. Y. Closely resembles the gneiss of Manhattan Island. Specimen is 20 inches across.

Lafayette Boulevard. The area of serpentine is very small and is now inaccessible on account of buildings. It is at Tenth Avenue and West Fifty-eighth Street. The magnesian limestone, or dolomite, occurs in zones in Harlem, where it is now almost covered with buildings, and in the Kingsbridge section of the island, where a good exposure may be seen along the Spuyten Duyvil ship-canal.

The exact distribution of these rocks can best be learned from a study of the geological map of New York City and vicinity

which has been placed beside the local rock collection in the Hall of Geology. The collection has been arranged in two cases. One of these shows the kinds of rocks encountered when crossing the island from east to west at several points, while the other shows nearly all the varieties of rock which have been found in ledges on Manhattan Island. Three sections of borings, further-

QUARTZOSE VEIN IN MICACEOUS GNEISS

West End Avenue near Sixty-third Street. Specimen is 5¼ inches across.

more, show the rock found at considerable depths at widely separated points, and prove that there is no change from the surface.

The mica schists and gneisses are now considered by geologists to be shales and other clayey rocks of Hudson River (Lower Silurian) age which have been altered to their present crystalline

condition by heat and pressure combined with motion. The crystalline limestone, which is almost a marble in some beds, is much older, geologically speaking. Its present condition is due to the severe metamorphism which it has undergone in company with the schists. The hornblende schists are considered to be of igneous origin, which would indicate that this region experienced volcanic activity millions of years ago. These schists occur in comparatively small detached areas and are the highly metamorphosed representatives of the molten lava, which was forced into cracks in the old sedimentaries and solidified in the form of trap dikes or was poured out upon the ancient surface in sheets. The hornblende schist may be distinguished from the inclosing mica schist by its darker color, due to the abundance of black hornblende. Actinolite and tremolite schists occur in company with some of the hornblende schists. East of the Harlem River and north of Spuyten Duyvil Creek there is a gneiss resembling some of the Manhattan Island gneiss in appearance, which is older than that and antedates even the magnesian limestone.

The minerals of Manhattan Island are, for the most part, silicates of complex chemical composition, and they vary with the nature of the rock with which they are associated. It is comparatively easy, therefore, to group them according to their occurrence into the minerals of (*a*) the gneisses and mica schists, (*b*) the hornblende schists, (*c*) the granite and pegmatite veins and dikes, (*d*) the limestone beds and (*e*) the serpentine area, and this subdivision has been followed in the arrangement of the collection. In connection with the study of the specimens the visitor will do well to consult the geological map of New York and vicinity attached to the case and the chart showing the distribution of mineral localities on Manhattan Island which has been placed in the case. The chart is reproduced herewith.

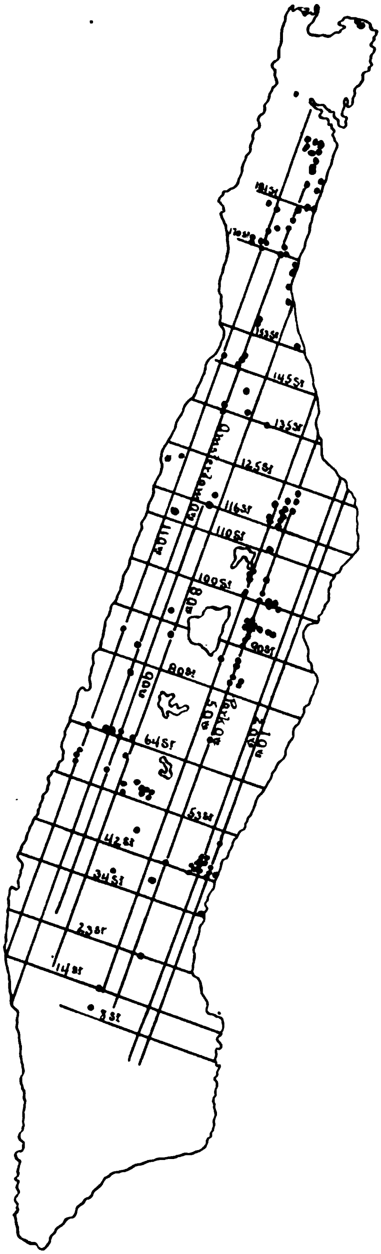
The minerals of the gneisses and schists are primarily quartz, feldspar and mica, the last predominating. In this association these minerals rarely occur upon Manhattan Island as handsome cabinet specimens, but there occur with them, as secondary effects of the metamorphism of the original beds, fibrolite, epidote and other species. Crevices in the schists have given

opportunity for the formation from circulating waters of interesting little globules of sphærosiderite and several members of the group of zeolites, such as heulandite, harmotome, stilbite and chabazite. The stilbite occurs in noteworthy rosettes of slender, blade-like yellowish brown crystals upon the surface of the rock. These zeolites are particularly interesting for study in comparison with the remarkable specimens of the same species which have come from the cavities in the trap rock (diabase) of the neighboring Palisades.

The chief cabinet mineral of the hornblende schists is sphene, which occurs in showy groups of yellowish green, flattened crystals. The principal constituent of the schists, however, is black hornblende, which occurs in needle-like crystals. Epidote too and actinolite are often found in this rock. Exposures may be seen in Morningside Park and the Fort Washington Heights section of the city, but most other localities have been covered with buildings or streets.

The granite and pegmatite veins or dikes are the principal contributors to the local mineral collection. The origin of these rocks is still a mooted point, but probably some of them are acid igneous intrusions, while others, particularly the pegmatites (characterized by their coarseness of crystallization), are the result of chemical precipitation from circulating waters. First to be mentioned are orthoclase, microline, oligoclase and albite among the feldspars; muscovite and biotite among the micas, and quartz. Garnets of small size are scattered all through the schists, but gigantic crystals of this mineral have been found in the pegmatite veins, the largest of which came from an excavation in West 35th Street between Broadway and Seventh Avenue. This garnet is a nearly perfect crystal six inches in diameter and weighs nine pounds ten ounces.

Black tourmaline is an abundant constituent of the schists, and it occurs in beautiful crystals in the pegmatites. Sometimes the minute, flattened crystals imbedded between plates of muscovite have been mistaken for the rare mineral dumortierite. Large crystals too have been found. An imperfect one, twelve inches long and five inches across, is in the Club collection, while a crystal of almost ideal development, about ten inches long and



SKETCH MAP OF MANHATTAN ISLAND

The dots indicate the situation of the principal mineral localities.

four inches in diameter, from near Fort Washington Avenue and 171st Street, is in the general Museum series.

Among other species which have been found in the granite and pegmatite veins mention may be made of allanite in the form of the long, lath-like crystals known as orthite, apatite, beryl, cyanite, dumortierite, iolite, monazite, ripidolite, wernerite, xenotime and zircon. Monazite is a compound of the rare elements cerium, lanthanum and didymium with phosphoric acid, and is the source whence the impregnating substance for the mantles of incandescent gas lights is obtained. Uraninite, or pitchblende, the chief source of radium, occurs on the island. Galena, the sulphide of lead, has been found in minute crystals on crystals of chabazite. Gypsum in radiating crystals on mica schist is one of the oddities of the collection, and fluorite (from the Subway) is another. Chrysoberyl, too, has been found in one locality. Azurite and malachite occur rarely on the island.

The limestone beds have furnished the collection with malacolite (white pyroxene), brown tourmaline and pretty groups of crystals of smoky quartz. Fibrous aragonite has been taken from thin veins in the limestone.

Finally, the serpentine area yields an intimate mixture of calcite and serpentine resembling the spotted green and white rock called ophio-calcite. Large specimens of this peculiar rock may be seen in the local rock collection in the Hall of Geology. At one time this mixture aroused considerable interest from the erroneous supposition that it corresponded with the famous Canadian "fossil" of Archæan age, *Eozoön Canadense*.

A complete list of the minerals of Manhattan Island would include the names of nearly one hundred species and varieties, and the region has been one of the most prolific in kinds in the world. Although most of the ground is now inaccessible, that which remains offers inducement to the diligent collector to search for mineral treasures to add to his cabinet.

EDMUND OTIS HOVEY.

MR. CHARLES B. CROOK has presented the Museum with an elaborate feathered head-dress, once worn by an East African chieftain.

DEPARTMENT OF VERTEBRATE PALÆONTOLOGY, EXPLORATIONS OF 1905.

THREE parties were sent into the field by the Department of Vertebrate Palæontology during the past summer. They carried on explorations and excavations in Montana, in central Wyoming and in southern Wyoming.

The party in southern Wyoming under Mr. Walter Granger went out especially in search of remains of the animals which lived in the Middle Eocene period in the region around the now abandoned military post of Fort Bridger. This classic locality has been explored from time to time since 1870, particularly large collections having been secured by Professor Marsh of the Yale Museum, by Professor Cope and by the Princeton Museum. American Museum exploring parties visited the region in 1893 and 1895 and again every season from 1903 to 1905, always seeking for remains of the so-called "mountain horse," or *Orohippus* of Marsh, an important stage in the development of American horses. After these six years of the most painstaking search, which were rewarded by the discovery of a great variety of other animals but by few or no remains of the horses, on the very last day of the final expedition, just as the search was being given up, the long-looked-for horse was discovered, the find consisting of the skull, limbs, backbone and other parts of the skeleton of the very stage which was needed to fit into the remarkable series which the Museum has been bringing together. Other valuable specimens were secured besides the "mountain horse." The most important of these were a nearly complete skeleton of one of the large carnivores of the period, a nearly complete skeleton and the skull of the running rhinoceros of the period, *Hyrachyus*, an unusually perfect skeleton of a rodent and a skull which may prove to be that of one of the Bridger monkeys. The staff of the expedition included Messrs. Miller of this Museum and Sinclair of the Museum of Zoölogy at Princeton.

The work of this season completes the very thorough survey of the ancient Bridger basin to which this Museum has now de-

voted six arduous years, beginning with the explorations of Dr. Wortman and ending with those of Mr. Granger. As a result of this work the geology of the basin is now thoroughly understood. It divides into a series of great steps or substages, each of which is distinguished by its own peculiar forms of life or of specific stages. Only in the upper stages do the great horned Uintatheres appear for the first time. During the season of 1904 the Museum secured the most complete skeleton thus far found of a Uintatherium, including the fore and hind limbs. This will now be mounted with the aid of certain portions of the type specimen of *Dinoceras mirabile* in the Yale Museum.

The party sent to central Wyoming under Mr. Peter Kaisen had a somewhat similar experience. They were exploring the "Bone Cabin" dinosaur quarry which has yielded such remarkable results during the past seven years. The output this season was in general singularly disappointing, indicating that the quarry was gradually playing out; but at the last a single find was made which repays the entire efforts of the whole season, consisting of the skeleton of one of the smaller Iguanodont dinosaurs remotely related to the famous Iguanodonts which are preserved in the Royal Museum of Brussels from the Bernissart quarries.

The work of this season ends our explorations in the Bone Cabin dinosaur quarry. Together with the fine specimens which have been found in other parts of Wyoming this quarry has given us an almost complete picture of the life of the Jurassic period, so that it has been decided to devote an entire hall to the animals, great and small, of this one stage in the history of the earth. In this hall the most imposing specimen will be the Brontosaurus, already mounted. Near it will be placed the skeleton of the carnivorous Laosaurus, part of the Cope collection presented to the Museum by President Jesup. This skeleton will be mounted in a unique manner upon the prostrate bones of another specimen of Brontosaurus which was found in the Como Bluffs in 1897. Materials are collecting for the mounting of *Diplodocus* and *Camarasaurus* or *Morosaurus*. The Bone Cabin quarry had yielded remains sufficient with some restoration from other skeletons to mount *Stegosaurus* entire. The speci-

mens above mentioned will give us a typical Iguanodont. The small "bird-catching" dinosaur of the period, *Ornitholestes*, is already mounted.

It is proposed to place these skeletons in the central portion of the hall, and in the side cases to exhibit the less complete skeletons and the anatomy of the limbs and other parts of the body, together with diagrams showing the localities in which the famous specimens have been found. It will, however, require several years' work in the laboratory before this exhibit can be completed.

It has not yet been possible to examine either the horse or the Iguanodont skeleton in the Museum, but as soon as they reach the East work will be begun upon them.

The most striking success of the year, however, attended the expedition to Montana. In 1902 Mr. Barnum Brown, who was in charge of this party, found a few remains of a very large carnivorous or flesh-eating dinosaur, imbedded in hard sandstone. The materials which were secured then included a portion of the skull and jaws, a few of the vertebræ of the backbone, part of the hip girdle and portions of the limbs. The fact that they represented such different parts of the body encouraged the hope that further exploration would reveal additional materials. Accordingly instructions were given that clearing and blasting above the locality where the specimen was found should be instituted on a large scale. As a result of this work as the summer wore on the additional remains of this great animal came to light, so that representative portions of the entire body have been secured by the Museum. The animal proves to be of gigantic size, the total length being estimated at 39 feet, the height of the skull above the ground at 19 feet. The new dinosaur is, in fact, the largest carnivorous land animal which has thus far been discovered. In reference to this powerful construction Professor Osborn has given it the name *Tyrannosaurus rex*, or the "king tyrant saurian." It was probably adapted to preying upon the great horned herbivorous dinosaurs of the period, known as Ceratopsia. This remarkable skeleton will be worked out and placed upon exhibition as soon as possible. It will form a worthy companion-piece to the great Brontosaurus.

TWO NEW BIRD GROUPS.

THE most recent additions to the splendid series of groups of North American birds which the Museum owes to the generosity of a number of contributors to a fund designed especially for exhibits of this nature represent the White-crowned Pigeon and the Ani.

The White-crowned Pigeon is a West Indian species which visits the Florida Keys in great numbers to nest in the smaller islets. In the Bahamas it is also migratory, appearing in May and frequenting the same localities year after year.

This Pigeon belongs to the same genus (*Columba*) as our dovecote Pigeon, and it is quite probable that in the warmer parts of the world it could be domesticated.

The flesh of this handsome bird is most palatable, and large numbers are annually killed for food in both the Florida Keys and Bahamas. Unfortunately, this great destruction of life occurs during the nesting season, but the fact that the birds are present only at that time has prevented, in the Bahamas, at least, the passage of laws prohibiting their killing.

The Ani is a species of Cuckoo common throughout the greater part of tropical America and occasionally reaching southern Florida. This bird is exhibited because of its remarkable nesting habits.

It does not mate in pairs, as do most birds, but the four to a dozen or more birds composing a flock live together throughout the year, building a common nest in which all the females lay their eggs. Twenty-one eggs have been found in a single nest, but the number laid by each individual is unknown. All the members of this singular family seem to take part in the duties of incubation and care of the young. The nesting season extends over several months, and fresh eggs may be found in a nest which contains young birds. It appears to be the universal custom of Anis to line their nests with fresh green leaves.

Little has been written about the nesting habits of the White-crowned Pigeon or Ani, and so far as we are aware the groups above-mentioned are unique.

MODELS OF MARTINIQUE AND MT. PELÉ.

THE Department of Geology has recently placed on exhibition a series of models illustrating the Island of Martinique and the effects of the eruptions of Mt. Pelé. There are four models in the series, comprising the whole island upon a scale of 1:80,000, modeled from the chart of the French Admiralty, and three enlarged models of the volcano itself, upon a scale of 1:24,000, or 2,000 feet to the inch, prepared from the same chart and photographic and other data obtained for the Museum in 1902 and 1903 by Dr. E. O. Hovey, Associate Curator of Geology. In all the models the vertical scale is the same as the horizontal. The first of the large-scale models shows the volcano as it was before and at the time of the first great eruption, that of May 8, 1902, which destroyed the city of St. Pierre and its inhabitants. The second large-scale model shows the changes which took place in the volcano in the succeeding months and includes the devastation wrought by the eruption of August 30, 1902. The third large-scale model shows the wonderful spine and cone of lava which was pushed out of the conduit and crater during the winter and spring of 1902 and 1903, the time selected for representation being April 2, 1903, which was at the period of maximum development of the strange structure. The models were prepared at the Museum by the Department of Preparation and Installation. They should be studied in connection with the 118 cases of specimens from Mt. Pelé and the window transparencies.

AMERICAN TUBERCULOSIS EXHIBITION.

FROM November 27 to December 9 one of the exhibition halls of the Museum was placed at the disposal of the National Association for the Study and Prevention of Tuberculosis and the Committee on the Prevention of Tuberculosis of the Charity Organization Society of New York for the purpose of exhibiting the practical work of the Association and the Committee, and demonstrating the methods that have been adopted to limit the spread of a terrible but preventable disease, and to cure persons

already suffering from it. The exposition consisted of exhibits of models, photographs, charts and diagrams from all over the country, and they showed that by far the most and the best work is being done in the city of New York by private as well as public institutions. Models of ward and pavilion tents from various hospitals, an out-door pavilion from Bellevue and photographs showing the treatment at hospitals and dispensaries where special work against tuberculosis is carried on formed an important part of the exposition.

The work of the tenement commission along the lines of preventing the spread of disease by ameliorating the conditions of living was illustrated by models, photographs and statistics. One exhibit consisted of the reproduction of a typical "dark room" in an inside tenement, and of a similar room under the new conditions imposed by the recent law compelling the admittance of daylight to such rooms. Unfortunately there are more than 300,000 such dark rooms still existing in the city. The character of the treatment of tuberculous patients at Saranac Lake, Stonywold and other sanitaria in the State was illustrated by means of photographs.

Great progress has been made at the Clinton State Prison in the treatment of consumption, which is one of the greatest scourges of penal institutions. The model of a ward for consumptives in the Clinton Prison was a feature of the exposition. Outside of New York City and State, Boston and Chicago are the principal cities carrying on a definite campaign against tuberculosis, and much work is being done in Massachusetts outside of Boston and in Maine, Rhode Island, Connecticut, Pennsylvania and Colorado.

The exposition was opened by public exercises in the Museum auditorium at which addresses were made by Talcott Williams, Esq., of Philadelphia, Doctor Thomas Darlington, Commissioner of Health in New York City, and President Morris K. Jesup. On Wednesday evening, November 29, a special meeting devoted to tuberculosis and the trades was held at which the principal address was given by Mr. Graham Taylor of Chicago, and short addresses were made by official delegates from the Central Federated (labor) Union. On Friday evening, December

1, there was a special meeting for physicians at which addresses were made by Dr. Lawrence Flick of Philadelphia, Dr. W. A. Evans of Chicago, Dr. A. Jacobi of New York and Dr. Vincent F. Bowditch of Boston. On Friday evening, December 8, a meeting expressly for the teachers of the public schools was held with the coöperation of the Board of Education of the city of New York, at which the principal address was delivered by Dr. S. A. Knopf of New York.

From here the exposition was transferred to Boston, and from there it is to go to Philadelphia, Chicago and other large cities throughout the country for the enlightenment of the people in the present wide-spread campaign against tuberculosis.

MUSEUM NEWS NOTES.

THE Department of Entomology has received as a gift from William Schaus, Esq., formerly of New York City, a valuable collection of moths embracing some 26,000 specimens, mainly from Mexico, Central America and South America. This collection is the result of about three years of assiduous search, much of which was done under the personal direction of Mr. Schaus, who is a tireless traveler and an enthusiastic entomologist. Four years ago the Museum received from the same gentleman a collection of 5000 butterflies, including many rare specimens from Europe, Asia, Africa, Australia and New Zealand.

THE Department of Ethnology has received as a gift from George S. Bowdoin, Esq., a member of the Board of Trustees, a valuable collection illustrating the fast-disappearing culture of some of the tribes of Central Africa. The collection includes implements of warfare, idols, fetiches and masks, clothing, baskets and musical instruments, household utensils of bamboo, pottery and brass, bracelets, necklaces and household adornments of beads, shells and brass. A large gold bead weighing three ounces and seven carved ivory tusks from Ashantee are worthy of particular mention.

THE Museum has recently acquired a collection of South American pottery containing nearly 200 pieces of black-ware coming from about thirty miles southwest of Supia, Colombia, in the valley of the Cauca River, which is a tributary of the Magdalena. This pottery is washed out and cast aside by the Indian placer miners who wash (sluice) the ancient burial grounds of the valley for the purpose of obtaining the antique gold objects which are frequently found in the graves and which are valued solely for the metal. This pottery is remarkable for its strong modeling, but poor technique. It represents conventionalized forms of armadillos, monkeys, frogs, snakes, spiders, lizards, sloths and other animals indigenous to the region, as well as human figures. Some of the pieces show a strong sense of humor on the part of the maker. The representations of human beings are particularly instructive from the data which they furnish with reference to the use of various personal ornaments and utensils, which have been found in the country.

THE collections of the Department of Geology have been enriched during the past quarter by the accession of considerable material from the Lewis and Clark Exposition at Portland, Oregon. This material includes valuable series of gold, silver and copper ores, oils and other economic products from the State Commissions of Utah, Wyoming, Idaho and California, together with extensive series illustrating the mines of Oregon and Montana and the work which was carried on under the auspices of the U. S. Geological Survey upon the black sands which occur in remarkable abundance along the Pacific coast. These sands have been shown to carry commercially valuable amounts of iron ore (magnetite), monazite and garnet; some of the sands containing also gold and platinum.

THE economic collections of the Museum have received an important loan exhibit in the form of a series of about one hundred samples of peat and the briquettes made from peat, lignite (brown coal) and coal slack. The series was collected by H. H. Wotherspoon, Jr., and was made for the purpose of

showing the commercial possibility of utilizing local supplies of cheap fuel material where the price of good coal is too high to permit its consumption.

THERE has been placed on exhibition a group of Texas rattlesnakes, the material for which was collected by Professor Wheeler and Doctor Dahlgren on a trip to Arizona last spring.

MODELS of two of our commonest and most beautiful forms of colonial Polyzoa have been prepared by Dr. B. E. Dahlgren, assisted by Mr. H. Mueller. Dr. Dahlgren has also completed a model of a rotifer, enlarged about 700 times, which shows one of these microscopic forms of low animal organism. These models are on exhibition in the Synoptic Hall, No. 107, of the ground floor.

THE Department of Mammalogy received in December a series of eight hippopotamus skulls showing various stages of growth from the young to the adult from Lake Ngami, South Africa. The largest of the series represents an animal of about the size of "Caliph" in the Central Park Menagerie. The department has also secured four huge giraffe skulls from Bechuana Land, South Africa. Comparison with the skull of the Museum's mounted giraffe skeleton shows that these newly acquired skulls must have belonged to animals 18 feet high, or half again as large as the mounted specimen on exhibition in the Museum.

THE Philippine wood collection has been removed to the corridor on the ground floor leading from the North Wing to the engine room, where it will be installed in a manner to show to the best advantage the beautiful grains and colors of the specimens. This collection is the most complete that ever has been made, and it represents all the woods of the Philippines which are valuable for manufacturing purposes.

THE annual meeting of the National Association of Audubon Societies, Mr. William Dutcher, President, was held in the Museum, October 31, members being present from Massachusetts, Rhode Island, Connecticut, New York, New Jersey, District of

Columbia, North Carolina and Oregon. The sessions were well attended, and the members were enthusiastic over the sound financial condition and the bright prospects of the Association.

THE Twenty-third Congress of the American Ornithologists' Union was held in the Museum, November 13 to 16, under the presidency of Mr. Charles F. Batchelder. There are now about nine hundred members of the Union, and the attendance at this Congress was greater than at any previous session. Many valuable papers were read, and a feature of the convention was an informal reception in the Museum.

AMERICAN MUSEUM BULLETIN, VOLUME XXI.

DURING the year 1905 the twenty-first volume of the BULLETIN of the Museum has been published. The articles are also published separately and may be obtained at cost prices from the Librarian. The table of contents of the volume is as follows:

LECTURES.

MEMBERS' COURSE.

THE second course of lectures for the season 1905 and 1906 to Members of the American Museum of Natural History and persons holding complimentary tickets given them by Members will be given during February and March. The programme for the course will be issued in January. The lectures will be delivered on Thursday evenings at 8:15 by members of the scientific staff of the Museum and will be fully illustrated by stereopticon views.

PUPILS' COURSE.

THE programme of the first course of lectures to the public school children for the season, was as follows:

	Oct.	Nov.	Dec.	
Monday,	16,	13,	11.	—Mr. G. H. SHERWOOD, "A Tour of Our Philippine Possessions."
Wednesday,	18,	15,	13.	—Mr. H. I. SMITH, "Methods of Transportation—Past and Present."
Friday,	20,	17,	15.	—Prof. M. H. SAVILLE, "A Trip Through Mexico to Panama."
Monday,	23,	20,	18.	—Mr. G. H. PEPPER, "Life Among Our Indians."
Wednesday,	25,	22,	20.	—Mr. F. M. CHAPMAN, "City Bird Life."
Friday,	27,	24,	22.	—Mr. G. H. SHERWOOD, "The Industries of the United States."
Monday,	30,	27,	Jan. 8.	—Mr. L. P. GRATACAP, "The Development of New York City."
Wednesday,	Nov. 1,	29,	10.	—Dr. E. O. HOVEY, "The Work of Water."

	Nov.	Dec.	Jan.	
Friday,	3,	*	12.	—Mr. R. W. MINER, "Travels Through Western Europe and British Isles."
Monday,	6,	4,	15.	—Dr. E. O. HOVEY, "The Physical Divisions of the United States."
Wednesday,	8,	6,	17.	—Mr. C. W. MEAD, "Our South American Neighbors."
Friday,	10,	8,	19.	—Mr. R. W. MINER, "In the Nile Country."

The second course for the season will be given during the spring months according to a programme which will be announced in February.

These lectures are open to public-school children accompanied by their teachers and to the children of Members on the presentation of their membership tickets. Particulars regarding this course may be learned by addressing the Director of the Museum.

LEGAL HOLIDAY COURSE.

UPON the four principal legal holidays occurring during the winter season the Museum has, for many years, given lectures free to the public, no tickets being required for admittance. The programme for the current season follows. The doors are open at 2.45 P.M., and the lectures begin at 3.15 P.M.:

Thanksgiving Day, November 30, 1905.—PROF. ALBERT S. BICKMORE, "Antwerp, Brussels and Waterloo."

Christmas Day, December 25, 1905.—DR. EDMUND OTIS HOVEY, "Northern Mexico: Its Deserts, Plateaux and Canyons."

New Year's Day, January 1, 1906.—PROF. ALBERT S. BICKMORE, "The Philippines—Manila."

Washington's Birthday, February 22, 1906.—PROF. ALBERT S. BICKMORE, "The Philippines—Luzon."

PEOPLE'S COURSE.

THE second course of Free Lectures to the People, which are given Tuesday and Saturday evenings in coöperation with the Department of Education of the City of New York, will begin in January according to the following programme:

Tuesday evenings at 8 o'clock.

A course of lectures on the geography of Eastern Countries.

* On account of the Thanksgiving holidays the lecture was omitted on December 1.

January 9.—Dr. LEWIS GASTON LEARY, "Jerusalem." Illustrated by stereopticon views.

Three lectures by Mrs. CASSANDRIA A. HAYNES:

January 16.—"To and Fro in Babylon." Illustrated by costumes.

January 23.—"Bedouin Arabs and Things Seen among Them." Illustrated by costumes.

January 30.—"In Reed Encampments." Illustrated by stereopticon views.

Four lectures on Egypt: Life, Religion, Art and Symbolism, by Prof. WALTER SCOTT PERRY, of Pratt Institute. Illustrated by stereopticon views:

February 6.—"The Nile Valley. The City of Cairo. Native Village Life. Agriculture. Mounds and Excavations. Religion, Writing and Symbolism of the Ancient Egyptians."

February 13.—"Ancient Thebes. The Wonderful Temples of Luxor and Karnak. Ceremonies and Festivals. The Temple of Edfu."

February 20.—"Ancient Memphis. The Pyramids. Tombs of the Early and Middle Empires and the Significance of Their Remarkable Decoration."

February 27.—"The Memorial Temples of Thebes. The Tombs of the Kings. Decoration and Symbolism. Sculpture and Ornament. Influence of Egyptian Art."

Saturday evenings at 8 o'clock. All lectures illustrated by stereopticon views.

Three lectures on entomology by Prof. JOHN B. SMITH, of Rutgers College:

January 6.—"Insects and Their Transformations."

January 13.—"Insects in Their Relations to Plant Life."

January 20.—"Insects in Their Relation to Man and to Other Animals."

Five lectures on the solar system by Prof. ROBERT W. PRENTISS:

January 27.—"The Sun: Its Phenomena."

February 3.—"The Sun: Spectrum Analysis, Light and Heat."

February 10.—"The Moon: Its Appearance, Motions, Scenery and Physical Condition."

February 17.—"The Planets: Their Telescopic Appearance and Physical Condition."

February 24.—"Comets and Meteors: Their Mutual Relations."

The lectures of the People's Course are open free to the public and no tickets are required for admittance, except in the case of children, who will be admitted only on presentation of the ticket of a Member of the Museum. The doors are open at 7:30 o'clock and close when the lectures begin.

The programme of the third course of the Public Lectures will be issued by the City Board of Education in February.

MEETINGS OF SOCIETIES.

THE meetings of the various societies that make the Museum their home will be continued until May. Papers on technical and general scientific subjects are read at these meetings. The papers and discussions are often of popular character and are always of considerable general interest. The public is invited to attend the meetings, and Members of the Museum will be provided with programmes on making request of the Director.

The New York Academy of Sciences holds its meetings on Monday evenings at 8:15 o'clock, as follows:

January 8.—Business meeting and section of Geology and Mineralogy.

January 15.—Section of Biology.

January 22.—Section of Astronomy, Physics and Chemistry.

January 29.—Section of Anthropology and Psychology.

For the remainder of the season the Academy will hold its meetings in the following order:

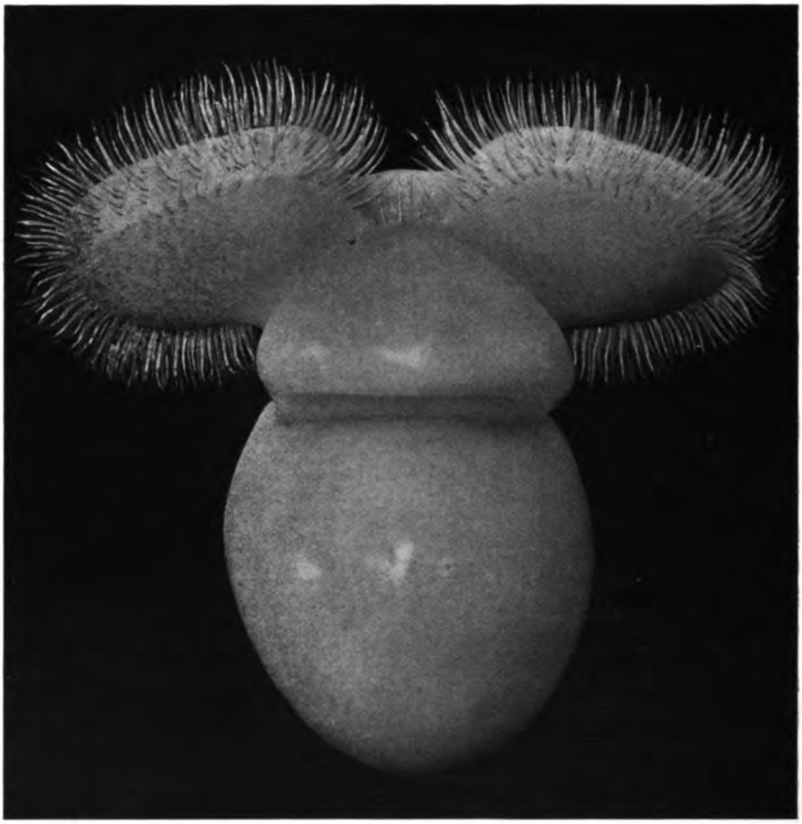
First Mondays.—Business meetings and section of Geology and Mineralogy.

Second Mondays.—Section of Biology.

Third Mondays.—Section of Astronomy, Physics and Chemistry.

Fourth Mondays.—Section of Anthropology and Psychology.

On Tuesday evenings and at other times as announced by the Secretary meetings are held by the New York Linnean Society, the New York Mineralogical Club and the New York Entomological Society.



MODEL 21. FRONT VIEW
The fully formed mollusk larva, or veliger.

THE DEVELOPMENT OF A MOLLUSK.[1]

A GUIDE TO THE SERIES OF MODELS ILLUSTRATING THE DEVELOPMENT OF CREPIDULA.

By B. E. Dahlgren, D.M.D.,
American Museum of Natural History.

Introduction.

THE problem of how living organisms arise must have ever presented itself to the questioning mind. The processes involved in the origin of new individuals nevertheless remained for ages an unsolved mystery. The most familiar example, the origin of the young bird from an egg, cannot have failed to arouse the interest even of primitive man. It must also have furnished the first suggestion towards an explanation. Although undoubtedly long unsuspected, in time it became known that every animal which does not multiply by simple division into two like the very lowest arises from an egg, which is either hatched or developed within the body of the parent. Until a century and a half ago it was generally believed that the egg contained a miniature animal, which became perfected during incubation. Not until the substance called protoplasm had been recognized as the universal "physical basis of life," and, by the aid of the microscope, all living bodies had been found to be composed of cells, was anything like a correct understanding of the nature of the egg and its development attained. The egg was found to be a cell derived like all other cells by the division of a preëxisting cell. Its development, resulting in the formation of the myriad cells of a new individual, was found to proceed by a process of cell-division, essentially similar to that by which growth takes place in the adult.

[1] Issued also in separate form as **Guide Leaflet** No. 21.

Out of the discovery of the character of the egg, of its origin from a parent cell and of its processes of development grew numerous other problems demanding the attention of investigators. Thus the science of embryology came into existence. This science seeks to discover every step in the development of an organism and to trace resemblances and differences of structure and form from their very earliest beginnings. It investigates the conditions which influence development and seeks to discover the factors which determine each step in the formation of an organism, to what extent development is dependent upon external causes and to what extent it is predetermined by the internal organization of the egg. It seeks to determine precisely what this internal organization is and to explain the manner in which the reproductive cell becomes the bearer of the characters of the parents and by what process it is able to transmit these to the offspring.

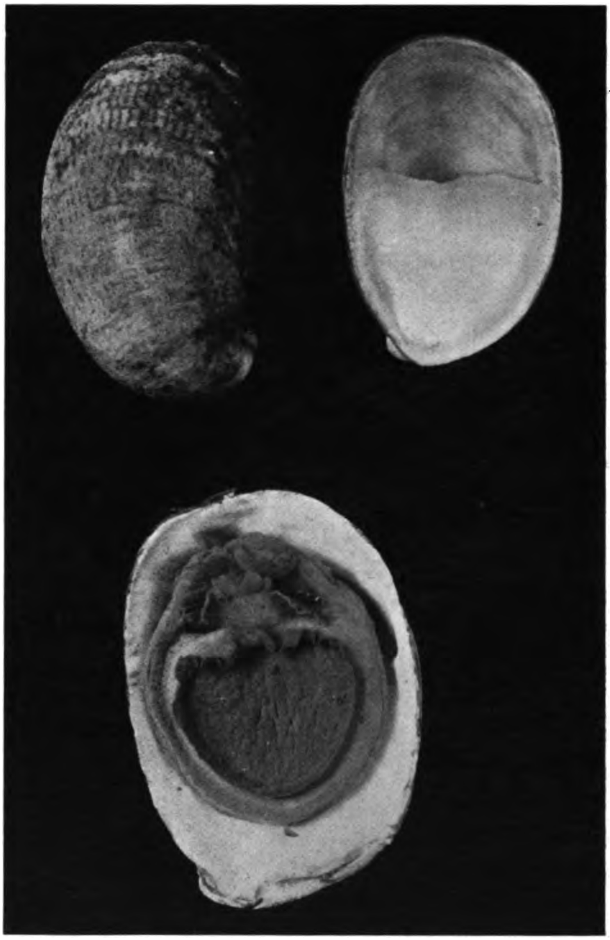
The comparison of the development of different animals soon revealed striking similarities at certain stages. It was found that after cell-division had proceeded to a certain extent the developing egg assumed a form resembling a mulberry (the morula); that later the cells invariably became arranged in the form of a hollow sphere (the blastula), this in turn giving rise to a somewhat more complicated flask-shaped form (the gastrula). It was seen that these various stages presented remarkable correspondences to certain lower forms of life. The analogy of the undivided egg to a simple unicellular protozoan; of the mulberry, or morula, stage to simple aggregations of unicellular animals such as are found among the lowest forms of life; of the blastula to certain Flagellates which occur in the form of hollow, free-swimming, multicellular spheres, and the apparent analogy of the gastrula to certain polyps led to the theory that the developing animal, in the course of its formation from the egg, passes successively through the forms of a whole series of lower organisms which may be considered as its ancestral types.

Formulated at a time when the evolution theory had been recently advanced, this corroborative theory aroused the liveliest interest. Although the original theory has been largely modified since the developmental history of a greater number of

forms has become known, comparisons such as these have thrown much light on the connections existing between various classes of animals, the extent to which developmental histories correspond being, in a degree, an index of relationships.

With a view primarily to increase the embryological evidences of evolution and at the same time to gain a clearer conception of relationships, the development of all the various types began to be traced from the original germ layers. Naturally the conditions which might influence development were considered, and explanations of how the mechanical action of simple physical factors, such as pressure, cohesion and gravity, might tend to cause a dividing egg of a given character to assume successively the various forms through which it passes during development, were soon advanced and received with great enthusiasm. To determine exactly how important a rôle these extrinsic factors play, and the extent to which the future form of an organism is predetermined by the intrinsic character of the egg is evidently of the greatest importance in the solution of the problem of heredity and constitutes at present one of the main problems of embryology .

Although the earlier embryologists were satisfied with simply tracing the origin of the various organs of the body from their primary germ layers which begin to be defined with the gastrula stage, nowadays the solution of the origin of every organ or feature of the body and the significance and factors of every step in development are sought by the most painstaking tracing of the history of every single cell arising by every succeeding division of the egg. It was with a purpose such as this that an elaborate and careful study of the development of *Crepidula* was undertaken by Prof. E. G. Conklin, of the University of Pennsylvania. This study has been followed by the author in constructing for the American Museum of Natural History the series of models described in the present paper.



THE SLIPPER LIMPET OR BOAT SHELL
Crepidula fornicata Lamarck

The Development of Crepidula.

The models represent on a greatly enlarged scale (about 400 diameters) the more important stages in the development of the egg of a gasteropod mollusk of the genus *Crepidula*—the Slipper Limpet, or Boat Shell—common on the coast of the United States. The exceedingly minute eggs (.182 mm. in diameter) are laid in great numbers in capsules secreted by the mollusk. These

capsules, to the number of 50 or 60, each containing about 250 eggs, are united into a grape-like cluster generally found under the shell of the Crepidula attached to the stone or other object upon which it lives its sedentary life. The total number of eggs laid at one time by an animal is about 13,000.

The unfertilized egg (Fig. *a*) is a nearly spherical single cell consisting of a very small amount of protoplasm surrounded by a relatively larger amount of yolk material, mostly in the form of small globules. Within the protoplasm, in a nearly central position, is found the nucleus of the cell. The whole egg is enveloped by a cell membrane.

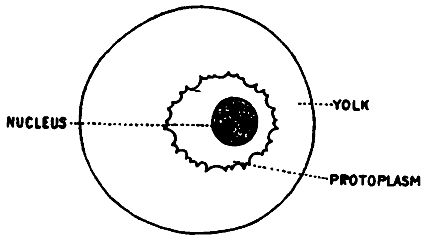


FIG. *a*

The first change which takes place in the egg, preparatory to development, is a migration of the nucleus and protoplasm from a central position toward the upper surface of the egg, the yolk, or deutoplasm, taking its position below it. The egg thus becomes distinctly symmetrical about a vertical axis (Fig. *b*). The upper pole, at which the protoplasm is found, is known as the *animal* pole; the opposite, or lower, as the *vegetative* pole, since

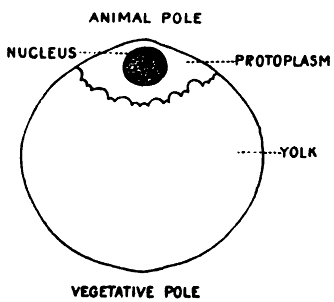
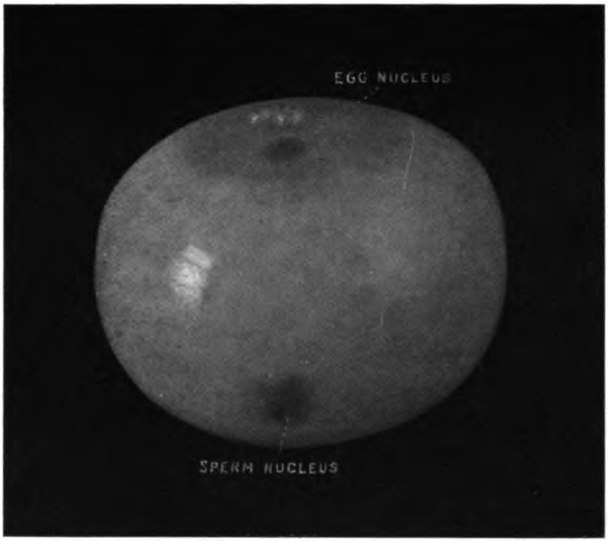


FIG. *b*

about this is collected the yolk or food material contained in the egg. This axis may be followed throughout the development and has been found to correspond to the dorso-ventral axis of the future larva.

About the time of the change in the position of the nucleus and protoplasm, a division of the former takes place. One of the portions resulting from this division, surrounded by a small amount of protoplasm, is extruded at the animal pole, where it remains for a time as a minute body. This is the "first polar



MODEL 1, A

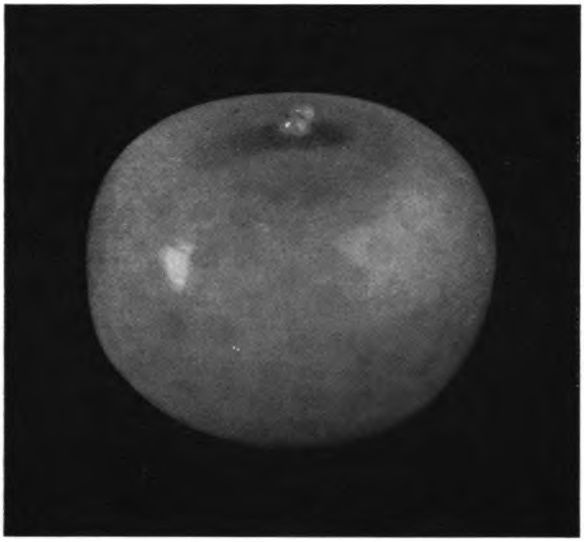
The individual egg showing the clear protoplasmic area above, under the two polar bodies; the yolk with the yolk globules below. In the protoplasm at the animal pole is seen the egg nucleus. The sperm nucleus is represented shortly after entering the lower half of the egg.

body" and is the larger of the two adherent bodies shown in Model 1,B.

This process of division of the nucleus is soon repeated, and a second smaller polar body is extruded. These two polar bodies remain in position for a considerable length of time. Although they do not take any part in the future development, becoming ultimately detached and lost, their elimination is of

particular significance in the preparation of the eggs for fertilization. The process is known as the "maturation" of the egg.

The sperm cells are inclosed with the ova in the capsules. They consist chiefly of a nucleus with a very insignificant amount of protoplasmic substance. A single sperm cell enters the ovum somewhere about the vegetative pole, at the time of the beginning of the maturation process, and its nucleus gradually makes its way upward toward the egg nucleus, until the two nuclei are in contact. These nuclei, known as the "pronuclei" of the egg, may be seen in Model 1,B lying close together in the protoplasm at the animal pole. The egg is now fertilized and capable of developing into a new organism.



MODEL 1, B

The fertilized egg, showing the egg and sperm nuclei in contact at the animal pole. On either side of them are the centrospheres.

Each nucleus is composed largely of a peculiar substance, which has been given the name "chromatin," because of the readiness with which it assumes the stains used for coloring microscopic objects. Though little is known about the definite function and properties of chromatin, its importance is evidently very great, for it is found in the nuclei of all cells. Generally it is

seen as small particles in the form of loops or bands, more or less compactly arranged, and of a definite number in any given species. To these the name "chromosomes" has been given. The division of a nucleus seems to consist mainly in a careful separation of the chromosomes into two equal parts.

There is also present in connection with each nucleus a small body which seems to be the center of all nuclear changes, the "centrosome." Whenever any activity of the nucleus such as a division takes place, the centrosome is in evidence.

Centrosomes are to be observed in both of the pronuclei of the undivided egg, and radiations apparently extend from them to each separate chromosome. The arrangement of the chromatin now becomes looser, and the chromosomes are more widely separated. The centrosomes come to lie in diametrically

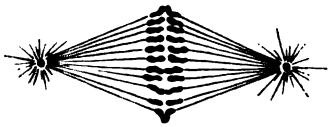


FIG. *c*

nuclear boundaries next disappear, the chromosomes become opposite positions with the two pronuclei between them. The

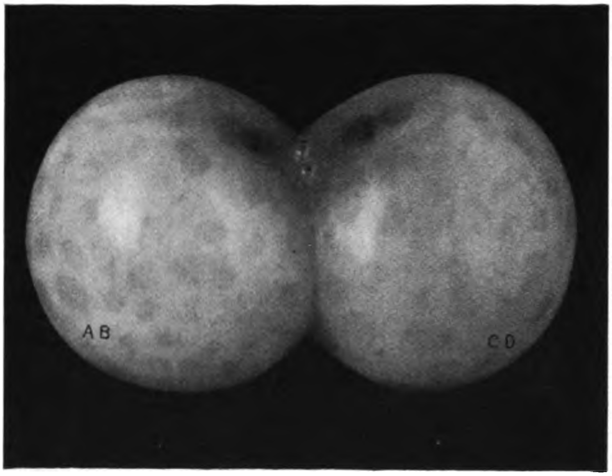
MODEL 2

First cleavage. Separation of chromosomes. Elongation and constriction of the egg preceding its complete division into two cells.

still farther separated, the radiations become more distinct, and soon seem to act on the chromosomes as two sets of fibers. The next step is a separation of every chromosome into two parts, which seem to be drawn in opposite directions toward the two centrosomes. These changes are shown in Model 2 and Fig. C.

In this manner two new nuclei are formed from the pronuclei, each new nucleus being composed of one-half of the chromatin of the male and female pronuclei, and each nucleus having a centrosome.

At the same time that the division of the pronuclei takes place a corresponding division of the whole egg occurs. The egg elongates (Model 2), a constriction takes place, and finally, coincident with the formation of the two new nuclei, there is

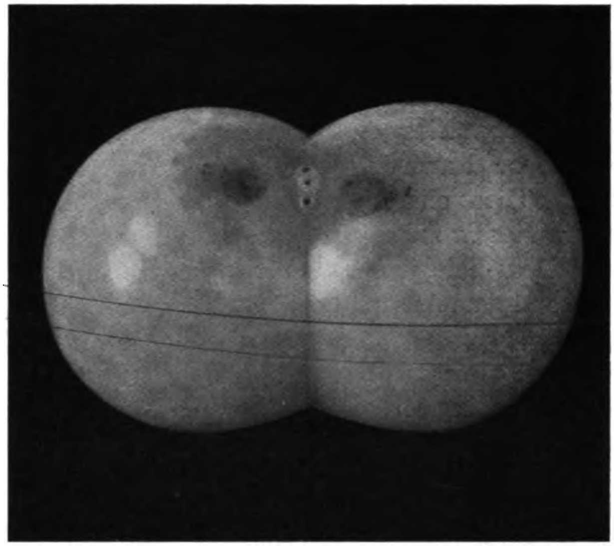


MODEL 3

Completion of first cleavage. Two cells. Polar bodies in the furrow between them. Daughter nuclei and centrospheres in each cell.

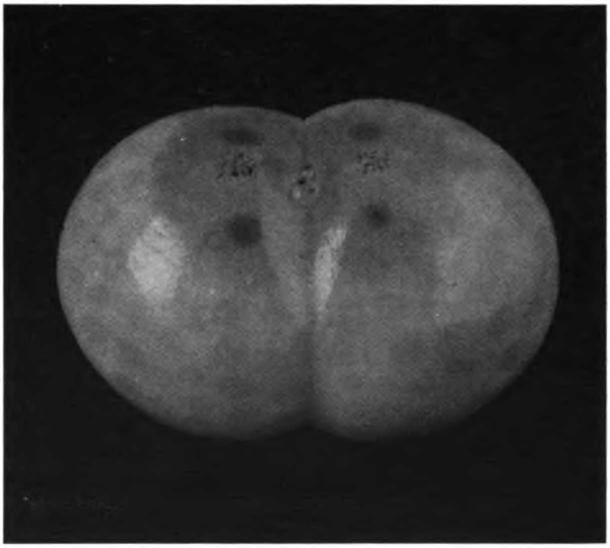
a complete separation of the egg into two halves, forming two new cells, each made up of protoplasm and yolk, like the single undivided egg, and each having a nucleus with its centrosome (Model 3). One of these two new cells gives rise to the anterior portion of the embryo, the other to the posterior.

Beginning with this, the first cleavage, up to the time when the larva is capable of taking in new food, the whole process of



MODEL 4

Resting stage after first cleavage. The two cells flattened against each other.

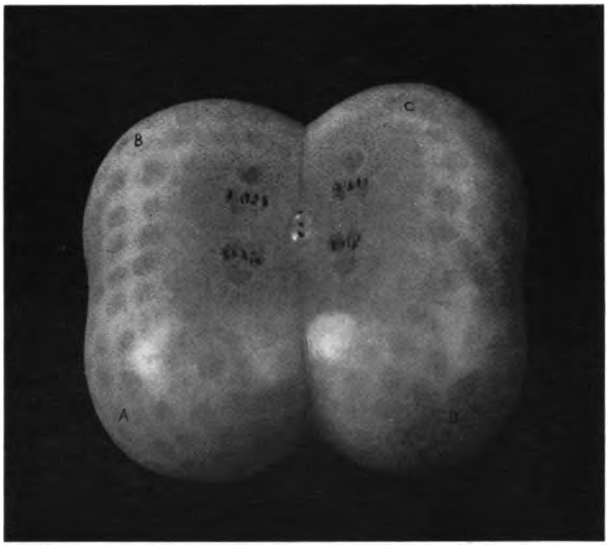


MODEL 5

Beginning of second cleavage. Nuclei resolved into division spindles. This model shows plainly two centrosomes, radiations and the two sets of chromosomes in each cell.

development proceeds through the repeated subdivision of these cells.

The second cleavage, which occurs at right angles to the first, divides the egg and the body of the future larva into right and left halves. This cleavage, initiated by a division of the centrosome, takes place by the changes in each nucleus, followed by an elongation and constriction of the cell. Finally a complete division of each nucleus and each cell into two parts takes place (Models 5 and 6). This gives four new cells, Model 7, each

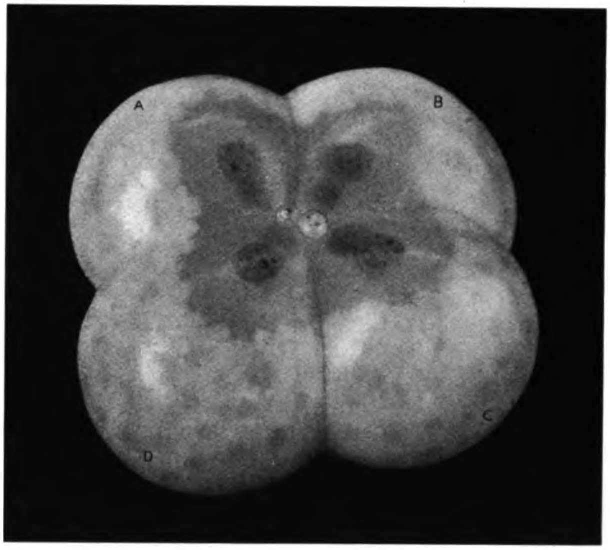


MODEL 6

Second cleavage. Further separation of chromosomes. The two cells elongated and showing a constriction.

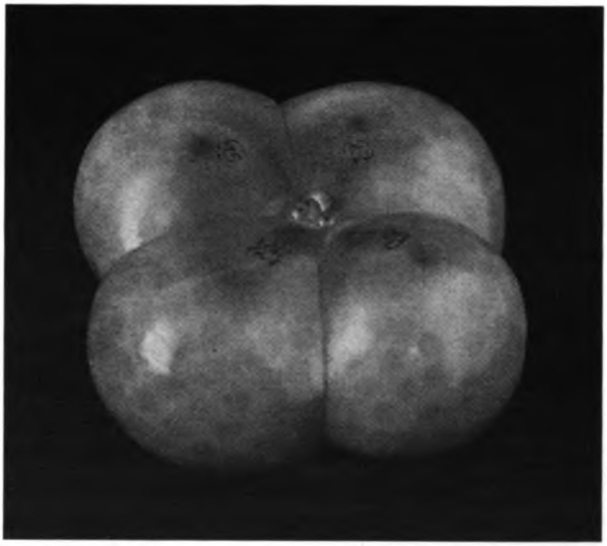
destined to form a definite part of the future organism, but each constituted as far as we can see in a precisely similar manner.

In the next, the third, cleavage the division takes place in a new direction. This, as indicated by the nuclear figures on Model 8, is oblique. Instead of a division into two equal parts, only a portion of the protoplasmic substance at the animal pole separates off, giving rise to four small cells which eventually lie above and slightly to the right of the four lower larger cells. (Model 9 shows the eight cells resulting from this cleavage.)



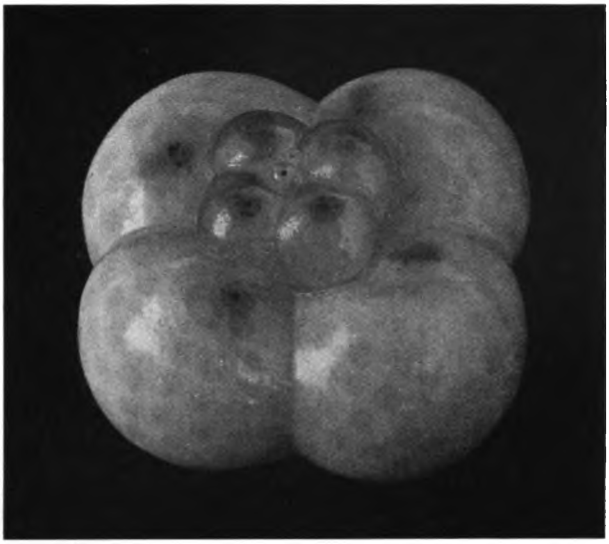
MODEL 7

Second cleavage complete, so that four cells are formed.



MODEL 8

Third cleavage. Division spindles radial. The raised surface at the inner end of each spindle indicates the point at which four new cells will be separated off.



MODEL 9

Third cleavage completed. First quartet of small cells or ectoblasts formed.

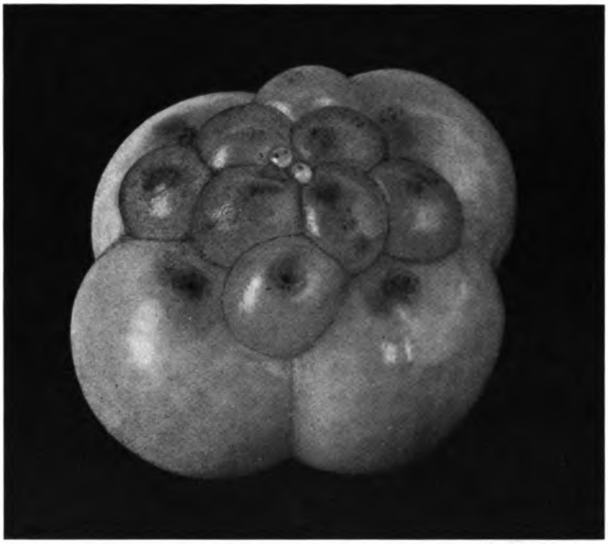
MODEL 10

Fourth cleavage begun.

The fourth cleavage (Model 10) is also oblique. It results in the separation of another quartet of small protoplasmic cells slightly to the left of the large yolk-laden cells and also at the animal pole (Model 11).

The fifth cleavage is simply a division of the first quartet of small cells (Model 12).

By the sixth cleavage, the beginning of which is shown in Model 12, a third and last quartet of similar small cells is given off at the animal pole. This cleavage also is oblique, but to the right. By this alternation in the direction of each cleavage



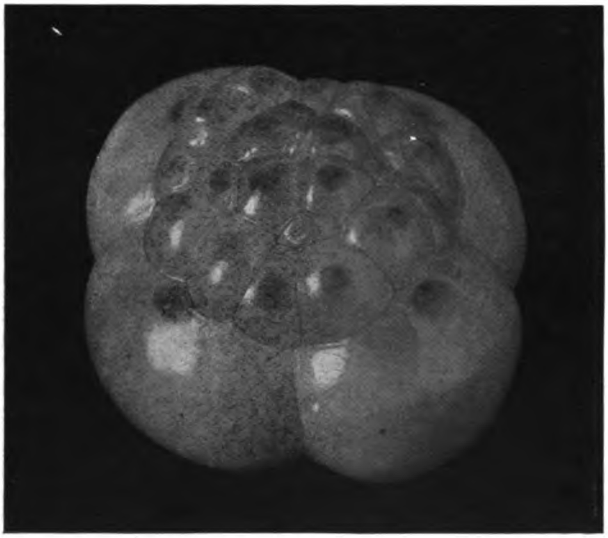
MODEL 11

Fourth cleavage completed. A second quartet of ectoblasts formed. Division beginning in cells of first quartet. Fifth cleavage begun.

plane, which began with first cleavage as indicated by the rotation of nuclei to the right, or in a clockwise direction on Model 4, the symmetrical arrangement of the cells is maintained. Lying at the animal pole of the egg, these three quartets of small cells form the so-called dorsal plate, which, by rapid multiplication of cells by division, is destined to grow until it completely covers the egg and forms the outer layer or ectoderm of the embryo. These cells are therefore known as "ectoblasts."

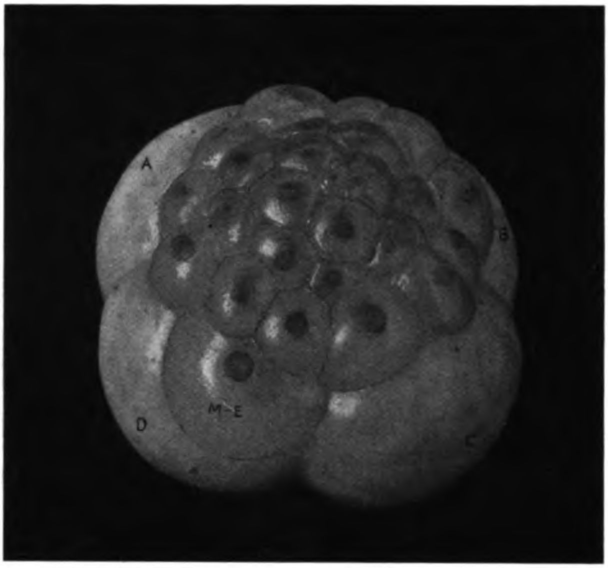
MODEL 12

Fifth cleavage completed. Sixth cleavage begun. Formation of third quartet of ectoblasts.



MODEL 13

Sixth cleavage completed. Second quartet has also divided; separation of ectoblasts completed.



MODEL 14

Separation from the left posterior large cell (D) of a single cell, the mesentoblast (M–E).

MODEL 15

Division of mesentoblast. The number of ectoblast cells has increased by further division of the three quartets.

The seventh cleavage (Model 12) divides the second quartet of ectoblasts.

The eighth cleavage (Model 13) consists of a second division of the first quartet of ectoblasts.

The ninth cleavage is unique, only one rather large cell, the "mesentoblast," M.-E. being separated off from the left posterior of the larger cells (D, Model 14). This new cell divides into two (Model 15) and again into four parts (Model 16). The upper two of these four cells, concealed on the model by the rim of the dorsal plate, multiply rapidly by division, and the cells which are formed from them make their way between the dorsal plate of the ectoblasts and the large yolk-laden cells below. They will form the future middle layer or mesoderm of the embryo, and

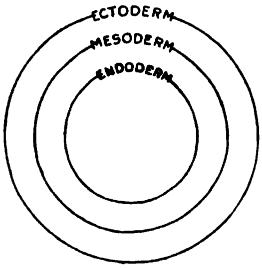


FIG. *d*

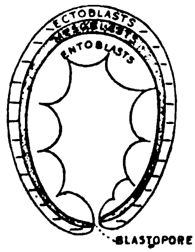
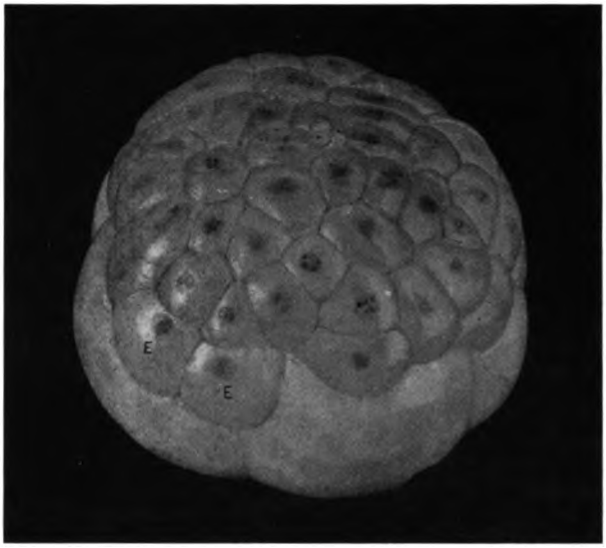


FIG. *e*

are known as the "mesoblasts." After the separation of the mesoblasts the remaining three large cells finally divide, giving in all eight or nine large inferior cells, the "entoblasts," which in time will form the inner layer of the embryo.

At an early stage there are thus separated in the egg the rudiments of the three layers distinguishable in the development of all higher animal organisms: ectoderm, mesoderm and entoderm. These may be diagrammatically represented as in Fig. *d*.

The ectoblasts by multiplication of cells soon extend over the entire ovum until only a narrow pore is left on the lower or ventral pole (Models 17, 18). Owing to the unequal rate of this growth, the upper or animal pole is at the same time shifted anteriorly till its angular distance from the lower vegetative pole becomes on this side only 90° (Model 18).



MODEL 16

Second division of mesentoblast, resulting in the formation of two mesoblasts and two entoblasts, which are concealed under the rim of the plate of ectoblasts, further divisions of ectoblast cell.

MODEL 17

Continued spreading of ectoblasts over the surface of the egg. Their origin from the three quartets is indicated in the model by colors: first quartet, red; second, blue; third, uncolored.

Immediately around the pore left by the closing of the edge of the ectoblasts is seen on this model the depression which indicates the beginning of the future mouth of the embryo. For a short time the pore itself is closed, but soon opens again and communication is thus established between the exterior and the internal cavity of the embryo. The structure of the embryo at this time may be represented diagrammatically as in Fig. *e*.

MODEL 18

The ectoblasts completely enclose the egg, leaving only a narrow pore (blastopore), about which is seen a depression. The derivation of ectoblasts from the three quartets indicated on the models by the coloring. The various regions of the future larva are becoming more sharply defined.

From this time on, the development consists of the differentiation by growth of the multiplying cells of these three separate layers into the specialized organs of the body.

The ectoderm cells which, as shown by the number of nuclei, are already very numerous, multiply rapidly in certain areas indicated by the slight outgrowths on the surface. These soon become more pronounced and form the beginning of the ectodermic organs of the embryo.

Above the mouth opening, which by this time is clearly defined, a ridge marks the beginning of the velum, or swimming organ, of the larva; below the mouth there is a large protuberance which will form the foot; at the sides of this two smaller knob-like outgrowths form the larval kidneys. At a point directly op-

MODEL 19

The larva begins to assume its definitive form. The mouth opening is formed; above it the curved edge of the velum is defined; below it the foot begins to protrude; on either side of this the first appearance of the larva kidney (EX) is indicated. At the lower pole of the model the shell gland is shown.

posite the apical, or head, end the shell gland develops (Model 18). Model 19 shows the shell beginning to be secreted by the shell gland.

The entoblast cells of the cavity of the gastrula by a process of unequal growth rapidly go to form the various parts of the digestive tube: stomach, liver, intestine etc. The œsophagus is formed by an invagination of the ectoderm from the exterior.

The middle layer, the mesoblastic layer, forms the muscles,

the circulatory system, heart and blood-vessels and the supporting tissues of the body.

Coincident with this differentiation of the regions of the body into organs, a change in the direction of the antero-posterior axis of the embryo takes place. The whole posterior portion is

MODEL 20

The formation of the veliger larva has proceeded farther. The various external organs are well defined. Below is seen the shell secreted by the underlying cells of the shell gland.

pushed ventrally: the mouth opening and the whole apical pole are shifted forward, and there is a twisting of the entire axis, plainly seen in the bending of the intestine. This organ, which originally lay in the mid-ventral line, assumes the form of an almost complete loop (Model 22). The asymmetry of the

mollusk larva is thus established and the definitive asymmetry of the adult is foreshadowed.

Models 21 and 22 show the completed larva, the free-swim-

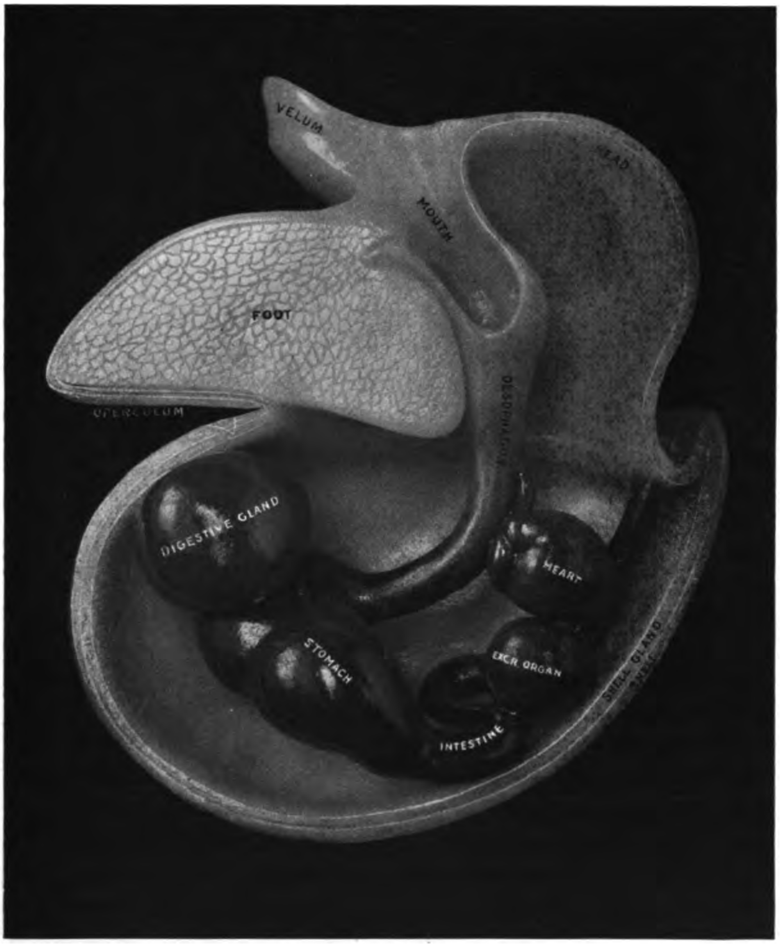
MODEL 21. SIDE VIEW

The mollusk larva, or the veliger, completed. The velum, or swimming organ, about the anterior end bears two rows of cilia. The foot is large and prominent and bears on its under surface the lid, or operculum, by which the opening of the shell is closed when the animal withdraws into it. On the head are seen the two eyes. The two raised points near these mark the position of the feelers or tentacles.

ming veliger with its fully formed ciliated velum, or swimming organ, the shell and the large foot, bearing on its lower surface the operculum, or lid, by means of which the shell is closed when

the animal withdraws into it. On the head are seen the two eyes and near them the tentacles.

The veliger stage, though more or less suppressed in land mollusks, is common to all gastropods. By an additional series of changes, consisting in a continued growth and development in certain directions, this larva is ultimately metamorphosed into the adult form of its species.



MODEL 22
A section of the veliger showing the internal anatomy.

APPENDIX.

TECHNICAL DESCRIPTION OF THE MODELS.[1]

1. A. The ovum of *Crepidula* at the time of fertilization.

1. B. The fertilized ovum showing pronuclei lying in the cytoplasm at the animal pole. On either side of them the centrospheres. At the vegetative poles is seen the yolk-stalk. Jour. Morph., Vol. XIII, 1897, fig. 1.

2. First cleavage—appearance of first cleavage furrow. Jour. Morph., Vol. XIII, figs. 3, 4.

3. Completion of first cleavage furrow. Nuclei and asters opposite each other in the two blastomeres. Between the blastomeres are the polar bodies. Jour. Morph., Vol. XIII, fig. 5.

4. Resting stage after first cleavage. Flattening of blastomeres against each other. Dexiotropic turning of nuclei, asters and protoplasmic areas. Jour. Morph., Vol. XIII, fig. 7.

5. Beginning of second cleavage. Læotropic turning of spindles and protoplasmic areas. The centrospheres of preceding cleavage lie near the cleavage furrow. Jour. Morph., Vol. XIII, fig. 7.

6. Second cleavage. Beginning of second cleavage furrow. Læotropic rotation of spindles. Polar furrow being formed. Jour. Morph., Vol. XIII, fig. 9.

7. Completion of second cleavage. Asters nearly in position of poles of preceding spindles. Polar furrow well formed. Jour. Morph., Vol. XIII, fig. 10.

8. Third cleavage. Spindles almost radial, but showing slight dexiotropic rotation. Jour. Morph., Vol. XIII, fig. 12.

9. Third cleavage. Completion of first quartet. Position of asters shows that division was dexiotropic. Jour. Morph., Vol. XIII, fig. 13.

10. Fourth cleavage. Læotropic. First quartet has rotated into furrows between macromeres. Jour. Morph., Vol. XIII, fig. 14.

11. Fourth cleavage complete. Fifth cleavage, læotropic division of first quartet of micromeres and formation of "turret cells" (trochoblasts). Jour. Morph., Vol. XIII, fig. 16.

12. Fifth cleavage complete. Sixth cleavage dexiotropic. Formation of third and last quartet of ectomeres. Sixteen cells. Jour. Morph., Vol. XIII, fig. 17.

[1] The models correspond to the figures in "The Development of Crepidula," by Dr. E. G. Conklin, Jour. Morph., Vol. XIII, 1897, and "Karyokinesis and Cytokinesis," Jour. Acad. Nat. Sci., 2d Ser., Vol. XII, Phila., 1902.

13. Sixth cleavage complete. Division of second quartet complete. Quadrangular plate of ectomeres with angles of plate in furrows between macromeres. Twenty ectomeres (4 apical, 4 turret and 12 belt cells) and 4 macromeres. Jour. Morph., Vol. XIII, figs. 19, 20.

14. Formation of first member of fourth quartet, the mesentoblast, from the left posterior macromere; formation of basal cells of cross by the second division of first quartet. Jour. Morph., Vol. XIII, figs. 22, 23.

15. Division of the mesentoblast completed, dexiotropic. Second and third quartets. Turret cells formed. Forty-two cells: 4 apicals 8 cross, 4 turret, 20 belt cells, 2 mesentoblasts, 4 macromeres. Jour. Morph., Vol. XIII, fig. 29.

16. Fourth quartet completed by læotropic cleavage of macromeres, A, B and C. The two mesentoblasts of the preceding stage have divided, forming the two enteroblasts and two primary mesoblasts which lie immediately above the latter, but concealed by the plate of ectoblasts. Jour. Morph., Vol. XIII, fig. 31.

17. Further division of ectoblasts. Expansion of arms a, b and c of ectoblastic cross into a cell plate. Anterior shifting of apical cells. Posterior turret cells undivided. Formation of quadrangular blastopores, the enteroblasts in posterior angle. Jour. Morph., Vol. XIII, figs. 51, 52.

18. Later stage. Apex on ventral side, slightly to the right. Cells of ectoblastic cross, first quartet, cover the whole anterior end of embryo. Large cells of posterior arm, dorsal. The closing of the blastopore and a depression about it indicating the formation of the stomodæum. The superior rows of ectoblast cells of second quartet, directly above the blastopore, form the first and second velar rows. The shell gland is forming at the postero-dorsal and somewhat to the left. Jour. Morph., Vol. XIII, figs. 65, 74, 75.

19. Older embryo, showing apical, posterior and pedal cell plates. On either side to the anterior and posterior of the dorsal cell plate, the velar rows are branching. Mouth and the external kidneys are formed, the shell gland expanding. Jour. Morph., Vol. XIII, figs. 76 to 79.

20. Older stage-formation of velum and foot. The shell gland greatly expanded and forming the shell of the veliger. Jour. Morph., Vol. XIII, figs. 80–82.

21. The fully formed veliger.

22. Section of the preceding.

New York.


FORESTRY
TREES OF NORTH AMERICA

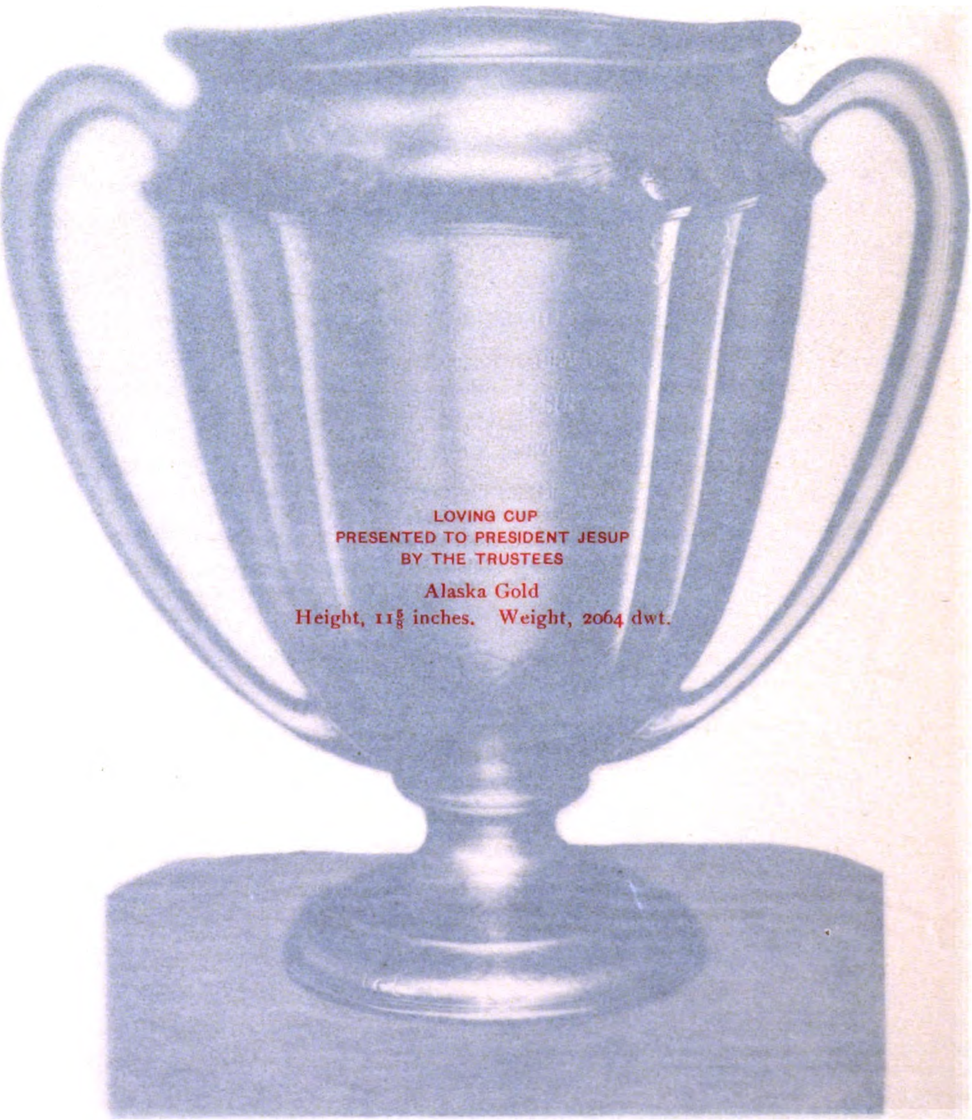

THE JESUP LOVING CUP
Anthropology–Forestry Panel

THE JESUP LOVING CUP

Zoölogy–Palæontology Panel

THE JESUP LOVING CUP
Zoölogy–Palæontology Panel


MORRIS
ADMINISTRATION



LOVING CUP
PRESENTED TO PRESIDENT JESUP
BY THE TRUSTEES

Alaska Gold

Height, 11⅝ inches. Weight, 2064 dwt.

The American Museum Journal

Vol. VI. APRIL, 1906. No. 2

THE TWENTY-FIFTH ANNIVERSARY OF THE PRESIDENCY OF MR. JESUP.

THE thirty-eighth annual meeting of the Board of Trustees of the Museum was held February 12, at the residence of Professor Osborn. The annual dinner followed the meeting, and at the close of the dinner after short addresses by Professor Osborn and Mr. J. Pierpont Morgan, Mr. Joseph H. Choate arose and on behalf of the Board of Trustees presented to President Jesup a gold loving cup bearing the following inscription:

1881 1906

FROM THE TRUSTEES
OF THE
AMERICAN MUSEUM OF NATURAL HISTORY
TO
MORRIS K. JESUP
ON THE
TWENTY-FIFTH ANNIVERSARY
OF HIS
PRESIDENCY OF THE MUSEUM
IN RECOGNITION OF HIS MOST ABLE
GENEROUS AND SUCCESSFUL
ADMINISTRATION
FEBRUARY 12th 1906

In his informal presentation speech, Mr. Choate referred to the critical period in the history of the Museum a quarter of a century ago when Mr. Jesup assumed the presidency, to the uninterrupted devotion which Mr. Jesup has shown to the highest interests of the Museum, to his generous gifts and to the rapid development of the Museum, which from a comparatively small beginning is now among the most important natural history museums of the world. Mr. Choate's address concluded with the presentation of the cup.

The cup is the work of Tiffany & Co., from designs indicating the principal branches of science which have been developed in the Museum and is commemorative particularly of the work in which Mr. Jesup has chiefly interested himself. The precious metal selected for the cup is gold from Alaska in reference to the President's interest in the North Pacific explorations. Around the base is a beautiful ornamental design taken from the work of the Amur River tribes, as shown in Volume VII of the Jesup North Pacific Reports. At the summits of the handles the gold relief work of pine leaves and pine cones and oak leaves and acorns is in reference to the collection of North American woods and forestry presented to the Museum by President Jesup.

The center of the cup is divided into four panels, the first of which contains the inscription above quoted. The second panel bears at the top the words GEOLOGY, GEOGRAPHY, beneath which is a design representing the cone of Mt. Pelé. The third panel bears at the top the words ANTHROPOLOGY, FORESTRY, and the design represents a Siberian native riding a reindeer with the words "North Pacific Expedition" beneath. The fourth panel is inscribed to ZOÖLOGY, PALÆONTOLOGY, with a design beneath composed of two of the fin-back Permian lizards, having under it the inscription "Cope Collection of Dinosaurs," in reference to the collection presented by Mr. Jesup.

Among the many changes marking the development of the Museum during the quarter of a century since Mr. Jesup was elected to the presidency the following may be mentioned as strikingly indicative of the feeling entertained by the President and heartily endorsed by the Board of Trustees that the museum which does not grow must cease to exist.

In 1881 there were only 54,500 sq. feet of floor space; now there are 570,158.

Then the building represented a cost of approximately half a million; now of approximately four millions of dollars.

In 1881 the city appropriated $10,000 for maintenance. It now appropriates $170,000.

Then there were twelve officers and employés; now there are one hundred and eighty-five.

The membership list has increased from approximately 800 to 2,000; the permanent endowment, from nothing to $1,013,000.

Before 1881 there were no publications, whereas the appropriation for publications alone for the current year is more than the entire appropriation of that year.

Before 1881 there were no public lectures. During the past year more than three hundred were delivered.

The meeting of the board was memorable, moreover, as bringing together for the first time in many years three of the original founders of the Museum, Messrs. Joseph H. Choate, J. Pierpont Morgan and Morris K. Jesup.

Henry Fairfield Osborn.

JOHN H. WINSER.

AFTER a brief illness with pneumonia complicated with heart trouble, Mr. John H. Winser, for many years secretary and assistant treasurer of the Museum, died Friday, January 12. At the annual meeting of the Board of Trustees the following resolutions were adopted:

"RESOLVED, That the Trustees desire to record their sense of loss in the death of Mr. John H. Winser, for so many years the faithful Secretary and Assistant Treasurer of the Museum.

"Mr. Winser was appointed to his office in 1892, and for fourteen years served the Board of Trustees and the officers of the staff of the Museum with the greatest fidelity. He was invariably accurate in all his accounts and records, absolutely trustworthy in all matters of administration, devoted to the best interests of the Museum, giving its interests his very constant thought and attention, and extremely courteous and kindly in his manner. When acting under the direction of the President or other members of the Board he could always be depended upon faithfully to represent their wishes and instructions. During all the long years of his service he never failed to do his duty to the best of his ability. His genial and kindly presence will be greatly missed at the Museum.

"*Resolved*, That a copy of this resolution be sent to the surviving members of his family with an expression of warm sympathy."

THE SCIENTIFIC PUBLICATIONS OF THE JESUP NORTH PACIFIC EXPEDITION.

DURING the year 1905 several important parts of the scientific results of the Jesup North Pacific Expedition were published under the editorship of Professor Franz Boas, who has had the direction of all the work.

Volume III, Part 3. *Kwakiutl Texts.* By Franz Boas and George Hunt.

This number closes the volume containing the Kwakiutl texts recorded by Mr. George Hunt and revised and edited by Professor Boas. The volume is almost entirely devoted to traditions relating to the ceremonies and the families of this important group of Indians. These traditions, which are numerous, are remarkably uniform, and they explain the large collection of ceremonial objects collected for the Museum. The traditions resemble those of the coast tribes living farther north, and they account for family and tribal privileges. The style of the text is diffuse, but has been preserved because the stories contain many data relating to the every-day life of the tribe.

Volume V, Part 1. *Contributions to the Ethnology of the Haida.* By John R. Swanton.

Dr. Swanton's work among the Haida of the Queen Charlotte Islands was undertaken in co-operation with the United States Bureau of Ethnology with the understanding that the ethnological results were to be published by the Jesup North Pacific Expedition. The deities of the Haida are divided into two groups in the same way as the tribe themselves; those of the Raven and the Eagle. Regarding the tribal clans the interesting conclusion is reached that according to the ideas of the Haida the Raven clan is indigenous to the islands, while the Eagle clan may possibly be descendants of emigrants from the main land.

The principal crests of the families, which represent certain prerogatives, are for the Raven clan, the killer whale and grisly bear, for the Eagle clan, the eagle and the beaver. Some of the totem poles which are such a familiar sight to tourists in

the region bear the crest figures of the house owner and his wife, while others represent incidents in myths. Grave posts, canoes and household utensils bear similar representations, and crests are used by the people as designs in tattooing their bodies. The secret societies of the tribes are owned by various families and the more important were introduced from the south. The volume contains a number of interesting maps compiled by Dr. Charles F. Newcombe on which the native names of places and the locations of towns have been recorded.

Volume VI, Part 1. *The Koryak.* By Waldemar Jochelson.

The subjects treated in this volume are the religion and the mythology of one of the most important of the tribes living in extreme eastern Siberia. The principal Koryak deity is Big-Raven, who is looked upon as the founder of the world and the creator of its inhabitants. He is appealed to through prayers, sacrifices and incantations. The Koryak have besides a vague conception of a supreme being who sent Big-Raven to the earth to establish order. This supreme being does not seem to interfere in detail with the affairs of man, but as long as he looks down upon the earth there is abundance and health, whereas disorder reigns as soon as he turns away.

Malevolent spirits are very numerous, and there are supernatural beings which are rulers of various parts of the country. The Koryak, therefore, make extensive use of charms representing supernatural beings for protection against spirits. Sacrifices both bloody and bloodless are offered to the supernatural beings. The most important of these sacrifices are of reindeer and dogs, and Mr. Jochelson describes in detail the peculiar custom of attaching the bodies of dogs to poles or to the trees which represent the village guardians. Shamanism too plays an important part in the life of the Koryak. Professional shamans who treat the sick are employed in the tribe in addition to the particular family shamans.

Among the Maritime Koryak elaborate festivals are held relating to whale hunts, while among the Reindeer Koryak the most important ceremonials pertain to the herd of reindeer. The burial customs of the people are complex and include cremation.

The mythology of the tribe is remarkably uniform and deals

for the most part with the marriages of the children of Big-Raven and of his struggles with supernatural beings. The book closes with a detailed comparison of the Koryak mythology with the other mythologies of Siberia and with those of the Eskimo and the North American Indians, from which the author concludes that the interchange of mythological elements between the Indians and the Koryak must be older than that between the Koryak and the Eskimo.

Volume VII, Part 1. *The Chukchee.* By Waldemar Bogoras.

This book shows the intimate acquaintance which the author obtained through continuous studies made in the Kolyma district from 1889 to 1898 and later investigations carried on for the Jesup North Pacific Expedition at Anadyr and along the coast of the Chukchee Peninsula, eastern Siberia. The volume for the most part is devoted to the material culture of the people and the author concludes that in earlier times the Chukchee lived on the coast and that the present residence in the interior and the domestication of the reindeer are comparatively recent events. At the present time too the Chukchee are divided into two sections, the Maritime and the Reindeer groups. The method of harnessing reindeer is peculiar to the Chukchee, who use the animal mainly for hauling sledges. The present method of dog harnessing in pairs is that used by other Siberian tribes, whereas formerly all the dogs were attached to one point of the sledge, as is the present custom among the Eskimo.

The Chukchee hunt the seal and other sea mammals in a manner essentially the same as that used by the Eskimo. The means employed for capturing land animals are a combination of those employed by the Eskimo and by the tribes of western Siberia. The Chukchee employ sinewback bows and composite bows similar to those found farther south. The iron work of the tribe is extensive and shows the influence of the Yakut and the Amur River tribes. Armor made of small pieces of iron linked together and arranged in horizontal rows was formerly used by the Chukchee. The neck was protected by a large wooden ring incased in hide.

Detailed descriptions are given of the tents, the clay lamps and household utensils, the food and the manufactures. The

women, particularly those of the Maritime Chukchee, are tattooed and the designs are believed to have a magical significance. Many of the ornaments worn by the people are considered efficacious as charms. The Chukchee, furthermore, are fond of games and sports. The maps which accompany the book give the ancient and the present distribution of the tribes of north-eastern Siberia. All the ethnological volumes of the expedition are profusely illustrated.

THE NEW METEORITE.

ONE of the most important announcements made at the annual meeting of the Board of Trustees was that through the generosity of Mrs. William E. Dodge the Museum had come into the possession of the great Willamette meteorite. This mass of iron, the weight of which is estimated at about sixteen tons, was found in the Willamette valley, near Oregon City, Oregon, in 1902. It is the largest meteorite which has been found in the United States, and is probably the most interesting mass of meteoric iron which has ever been discovered. A full description of the mass, which is the most valuable single specimen yet acquired by the Museum, having cost $20,600, is deferred to a later number of the Journal.

GUIDE TO THE COLLECTION OF LOCAL BIRDS.

We present in this number of the Journal the first installment of an article by Mr. Frank M. Chapman upon the collection representing the birds which are to be found within a radius of about 50 miles of New York City, taking the Museum as a center. The completing installment of the article will be published with the July Journal, and the whole article will be issued together in separate form as No. 22 of the Museum series of Guide Leaflets. The collection referred to may be found in the Hall of Local Birds, No. 303 of the third, or gallery, floor of the Museum building.

HINDOO SILVER WARE.

A LARGE and valuable collection of silver work from India has been presented to the Museum by Mr. J. G. Phelps-Stokes. There are in all forty-one pieces representing the best types of native work. The chief value of this collection to the Museum, however, is not in the technique of the objects, but with respect to their uses. Several types of the regalia of a dancing girl are represented. One pair of anklets bears a large number of bells with foot and toe pieces. There are also ear and neck ornaments in the form of crescents with similar bells attached. These dancers wear massive silver girdles with long circular clasps which are represented in the collection by a very handsome piece. There are two other pieces of particular interest, because they represent the conventional ornaments worn by girls before and after puberty. The one worn before puberty contains a girdle from the middle of which hangs a heart-shaped ornament, inlaid with bits of turquoise, while above extending upward and attached to the necklace is a broad band similar to the girdle. At the age of puberty this is discarded and a girdle of similar form, but with circular appendage takes its place, which is represented in the collection by a very handsome specimen consisting of a girdle with a double chain extending up over the shoulders around the neck and down the back to the girdle behind. These pieces come from the Central Provinces of India.

There are several objects of religious interest, two of which are shown in the illustration. One is a small shrine containing an image of the Buddha, wrapped in sacred cloth. Such a shrine is usually worn by priests, suspended from a neck chain or string of prayer beads; the other is an elaborate silver prayer wheel of Thibetan type and is probably one of the most valuable specimens in the whole series, since such objects cannot readily be secured, owing to their sacred character. There are several other religious objects, such as anklets worn by the priests, with a number of bangles attached indicating the rank of the wearer, and small vessels for holding and sprinkling sacred water over the worshipers. This collection is particularly valuable to the Museum for comparative study, because the anklets and foot

SHRINE OF BUDDHA THIBETAN PRAYER WHEEL

Hindoo Silver

ornaments of the Hindoo dancing girls are distributed westward from oriental countries into North Africa and even into Europe. It is also probable that the elaborate leg-rings and other ornaments of the Central and South African natives are in some way connected with those of India. Silver work found its way also into the regions occupied by the uncivilized peoples of Siberia, specimens of which are well represented in the collections of the Jesup North Pacific Expedition. C. W.

THE JOHN COLLINS WARREN COLLECTION.

PRELIMINARY announcement may be made of a very important acquisition which has come to the Museum and especially to the Department of Vertebrate Palæontology through the generosity of Mr. J. Pierpont Morgan. It is that of the John Collins Warren Collection which for many years has been behind closed doors in the Warren Museum of Natural History in Boston. The collection is particularly valuable on account of the skeleton of the famous "Warren Mastodon" which it contains. This was dug out of a swamp near Newburg, N. Y., in the extremely dry summer of 1845. It was put together and exhibited about the country until 1847, when it was purchased by Professor Warren, who was then president of the Boston Society of Natural History, and who was one of the leading naturalists of his day.

The skeleton was practically complete when found, the only parts missing being a few of the vertebræ of the tail, and a few bones of the tips of the toes. It is in equally perfect condition to-day except the tusks, which were injured when the animal was taken out. Fortunately the extremities and portions of the bases of the tusks are still preserved. What is most striking in the skeleton, as Professor Thomas Dwight, grandson of Professor Warren, observes in a recent article, "is not only its great height, some twelve feet, but its great breadth." Besides this magnificent specimen, which is the most perfect and the best ever found, the Warren Collection includes the fine skull of another mastodon, known as the "Shawangunk Head," parts of a third

specimen known as the "Baltimore Mastodon," and series of upper and lower teeth which together with the above form the principal subject of Professor Warren's great memoir published in quarto form in Boston in 1855.

The collection also includes the backbone and portions of the skull of the whale-like animal *Zeuglodon* formerly known as *Hydrarchus.* Another important feature of the collection is a series of Connecticut valley footprints of Dinosaurs, many of the specimens being of rare perfection. The skeleton of the *Ornithorhynchus* in the collection was probably the only one in the country, when it was obtained. There are also casts of palæontological specimens, some of which are very difficult to procure at the present time.

DEPARTMENT OF MINERALOGY.

SOME interesting additions to the Mineral Cabinet are worthy of notice, among which is a group of Olivine (Peridot) crystals from Egypt. The crystals show prisms, domes and pyramids with noticeable compression. This new source of Peridot has considerable interest. The Peridot gems of collections have largely come from the East, but their exact origin was unknown. Mr. Kunz has suggested that they must date back to the time of the Crusades, having been brought from the East, and from time to time found their way into commerce from churches and cloisters. The new locality is somewhere in Upper Egypt near the Red Sea, and was probably the source, or near the source, of the gems of the Levant. Some fine cut Peridots are to be seen in the Morgan Collection of Gems.

A specimen of the new and uncommon Chalmersite is among these additions. This mineral occurs in fluted orthorhombic crystals on dolomite, associated with pyrrhotite, chalcopyrite and siderite in the gold mine at Morro Velho in Minas Geraes, Brazil. The crystals are usually twinned, lustre metallic and color a bronze yellow.

Anapite from Anapa, Black Sea, in pale green plates is not altogether new to the collection, as a poorer but broader surface was previously secured, but the development of the plates is much more crowded and characteristic in the new specimen. The mineral is a hydrated phosphate of lime and iron.

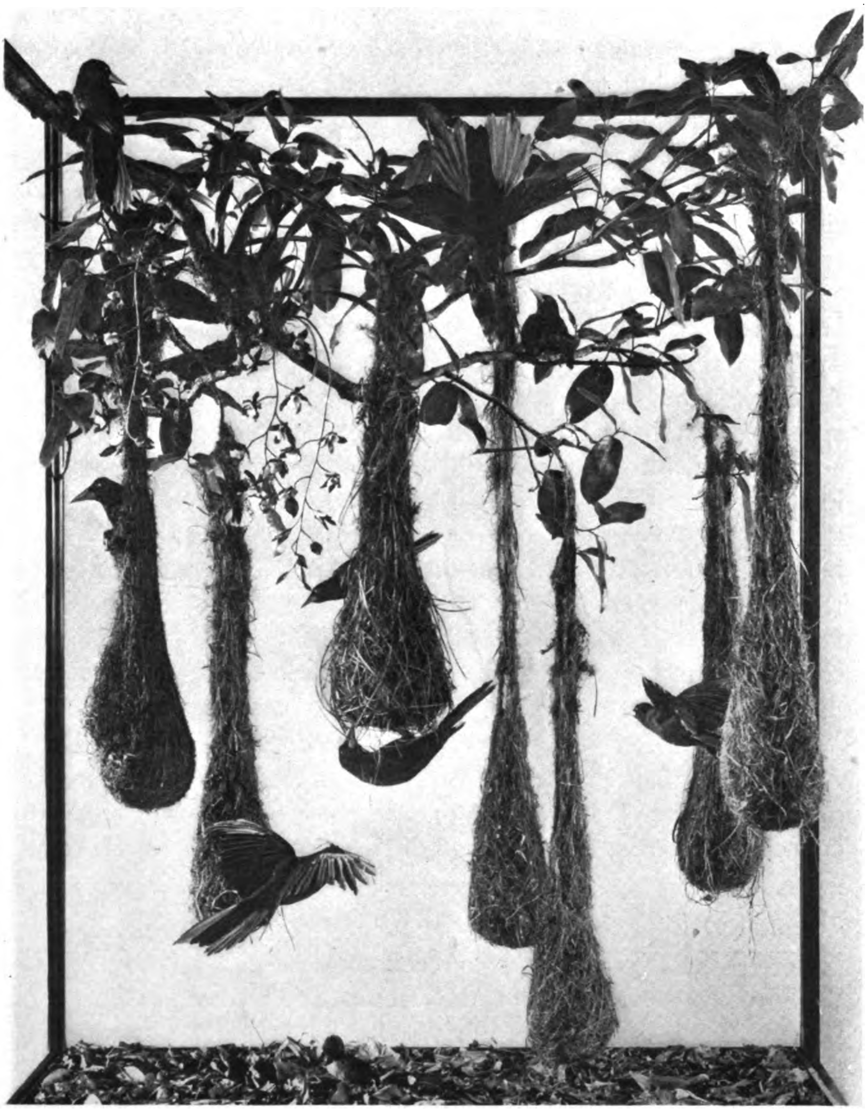
An elbow twin of Cassiterite like the familiar forms of Rutile from Parksburgh, Pa., is an interesting addition. This is from the classic locality of Morbihan, France, and though small is exceptionally perfect.

Two crystal fragments of Lapis Lazuli showing rhombic dodecahedral planes are valuable additions, since crystals of this mineral are phenomenally scarce. Teallite from Bolivia is another noteworthy addition to the cabinet. It is a new species, being the sulphostannate of lead. The exact locality is unknown though in all probability it comes from Poopó, where Franckeite and Cylindrite are found. It occurs in thin elastic flexible and cleavable laminæ. An elegant wire silver from Kongsberg, Norway, and a superb group of Stephanite crystals from Příbram, Hungary, Natrolite of relatively great size (for crystals), two unusual Beryls and an Indicolite Tourmaline, complete a small but valuable purchase, made with the assistance of the Bruce Fund.

L. P. G.

GROUP OF THE CRESTED CASSIQUE.

THE Crested Cassique, *Ostinops decumanus* (Pall.), which is also known by the names of Oropendula, Japú and Yellow-tail, is a tropical American relative of our Orioles, its nest, as the examples in the group show, being similar in plan to the smaller, bag-like structure of our Baltimore Oriole. The Cassique, however, not only builds a larger nest, but one hundred or more nests have been found suspended from the branches of a single tree. In spite of the comparatively small openings of the nests, the birds enter them in nearly full flight and when the presence of hungry young birds demands frequent visits by the parents, a colony



CRESTED-CASSIQUE GROUP
Hall No. 208

of Cassiques presents one of the most animated and attractive sights in the bird-life of our tropical forests. Following the rule that fewer eggs are laid by tropical than by northern birds, the Cassique lays but two eggs, while our Oriole lays four or five.

The Cassique possesses a great variety of loud calls and whistles, some of which are very musical. In the nesting season the male, which is noticeably larger than the female, has the singular habit of bending low his head while uttering a long-drawn creaking call, which he follows by flapping his wings violently together over his back. A bird in the upper part of the group is represented in this act.

The present species of Cassique is found throughout South America from southern Brazil northward to Panama, an allied species extending northward to Mexico.

Poised before the orchid (*Miltonia candida*) which appears in this group is a Hummingbird (*Florisuga mellivora*), while on the ground an Ant-Thrush (*Formicarius analis saturatus*) may be seen. The positions of the Cassiques, the Hummingbird and the Ant-Thrush in relation to their surroundings, illustrate the facts that brightly marked birds are, as a rule, found in the trees among leaves and blossoms, while the dull-colored species usually live on or near the ground.

The nests here shown were collected in Trinidad by Mr. A. B. Carr. The group was prepared at the Museum under the direction of Mr. J. D. Figgins and has been placed in the general collection of birds, Hall No. 208 of the second-floor, North Wing.

MUSEUM NEWS NOTES.

THE Library has received as a gift a copy of the catalogue of the Heber R. Bishop collection of jade. This unrivaled collection was presented by Mr. Heber R. Bishop during his life time to the Metropolitan Museum of Art where it has been installed in a room prepared for it at the expense of the donor. This catalogue is the most thorough investigation of the subject of jade and jade implements which has been undertaken, and it is considered to be the most magnificent example of the art of book-making which has been attempted in modern times. The

work consists of two folio volumes and is limited to an edition of 100 copies, none of which goes to a private individual, and none of which will be sold. These volumes measure 19 x 25 inches, are printed on the finest quality of linen paper, made expressly for the work and weigh respectively 69 and 55 pounds. They contain together 570 pages, 150 full-page illustrations and nearly 300 pen-and-ink sketches. This gift was made the subject of a special vote of thanks by the Trustees.

THE HON. SETH LOW, LL.D., has been elected to Patronship in the Museum.

THE Trustees have made the following changes in and additions to the membership of the Museum:

Mrs. Guy Ellis Baker was elected to succeed to the Patronship of her father, the late Gen. L. P. di Cesnola.

Mrs. F. A. Constable, to succeed to the Patronship held by her husband, the late Mr. F. A. Constable.

Mr. Adrian Iselin, Jr., to succeed to the Patronship of the late Mr. Adrian Iselin, who for many years was one of the Board of Trustees.

Mr. Adolph Lewisohn was elected a Patron, in reoognition of his gift of Alaskan ethnological specimens.

Mr. George G. Heye was elected a Life Member, in recognition of his gift of Socorro pottery.

Mrs. Albert Bierstadt was elected a Life Member, in recognition of her gift of Indian of ethnological specimens.

THE following persons have subscribed to Life Membership in the Museum during the year 1905.

S. T. Armstrong, M.D.
Geo. McKesson Brown
Katharine L. Cammann
J. E. Childs
Henry A. C. de Rubio
W. B. Dickerman
J. W. Dimick
Edward K. Dunham
Thomas T. Eckert, Jr.
Amos F. Eno
Allen W. Evarts
Charles J. Harrah
George A. Kessler
Guy R. McLane
James A. Macdonald
Charles Duncan Miller
Charles E. Milmine
Abram G. Nesbitt
Acosta Nichols
Trenor L. Park
O. H. Payne
Seymour Perkins
Henry Phipps
George R. Sheldon
Jens Skougaard
Wm. S. Thomas, M.D.
Richard L. Walsh
Henry de Forest Weekes
James Dugald White
James Gilbert White
Wm. Ziegler[1]

[1] Deceased

THE list of Annual Members of the Museum was increased by the addition of 210 new names during the year 1905.

THE changes in installation in the large wall cases in the Morgan Gem Room have been completed. The cases have been lined with velours, and the handsomest specimens of Jade, Malachite, Azurite, Quartz, Calcite, Sulphur, Feldspar, Gypsum, Fluorite, Tourmaline and Rhodonite have been mounted in them. Each specimen has received independent treatment to bring out its salient characters in the best manner possible. Most visitors will be surprised at the wealth of beautiful material displayed, particularly in Malachite and Azurite, the green and blue copper ores for which the Copper Queen Mine of Arizona has long been famous, Calcite, or Calc-spar, and Quartz, including some remarkable masses of Amethyst.

MR. RICHARD TJADER, a traveler and hunter of wide experience, accompanied by Mr. Herbert Lang, one of the Museum preparators, left New York on March 1 on an expedition into British East Africa (Uganda) for birds and mammals, particularly the large mammals of the region, for the Museum collections. The party will land at Mombassa on the east coast and proceed thence by railroad to Nairobi. From Nairobi advance will be made by circuitous route northward, westward and southward to Port Victoria on Lake Victoria, whence return to the coast will be made by boat and rail. The expedition has been provided for through the generosity of Mr. Samuel Thorne.

MR. BRUCE HORSFALL, the bird artist, spent two weeks in Florida in January making sketches and notes for the Museum groups representing the Brown Pelican, the Water Turkey, the Great Blue Heron and the Sandhill Crane. The trip was highly satisfactory, and the results will shortly appear in the exhibition halls. This is a part of the work being carried on under the North American Ornithology fund to which the Museum owes the San Joaquin Valley group, the Flamingo group and several smaller groups.

Through the generosity of a friend of the Museum, Professor H. E. Crampton of Barnard College, Columbia University, has been sent on an expedition to the South Sea Islands, particularly to study certain features of the fauna of the Tahiti group. The specimens collected by Professor Crampton are to become the property of the Museum.

Mr. J. H. Batty is in Mexico collecting birds and mammals for the Department of Mammalogy and Ornithology. He will make his way southward through Central America to South America before returning to the Museum.

Mrs. Albert Bierstadt has presented to the Department of Mammalogy an unusually large and fine mounted head of an American bison, which was taken by her husband many years ago while hunting on the Great Plains. The acquisition is particularly welcome on account of the practical extinction of the animal from its former extensive range. Mrs. Bierstadt has also given to the Department of Ethnology a valuable series of specimens consisting of baskets collected about fifty years ago, elaborately carved, wooden spoons from Alaska and large cedar chests with engraved and painted designs representing the Raven and the Killer Whale, together with specimens, such as beaded bags, drums, rattles and pipes, collected in early years from the Indians of the Plains.

The Demuth collection of pipes and smoking utensils has been considerably extended in the past few months by the addition of a large series of specimens of ceremonial and other pipes from various tribes of North American Indians, and from the Ashanti, the Kaffir, the Makalolo, the Bali and other tribes of central and southern Africa. A series of Filipino pipes and cigars is an important further addition to this collection.

A large group representing the Collared Peccary of Mexico has been installed in the Hall of North American Mammals, No. 206 of the second floor, and consists of a series of five of these pig-like creatures in their natural surroundings in southern Sinaloa, Mexico. The specimens and accessories were collected

near Escuinapa by Mr. J. H. Batty. The scene shows too the wonderful assemblage of thorny plants of several kinds characteristic of the hot semi-arid regions of our continent. The group was prepared at the Museum by Herbert Lang and Dr. B. E. Dahlgren.

A NEW group in the Siberian Hall, No. 101 of the ground floor of the building, represents some of the ceremonials of the Reindeer Chukchee, a large tribe inhabiting the extreme north-eastern part of Siberia, preparatory to starting out upon the annual reindeer hunt which provides these people with food and raiment.

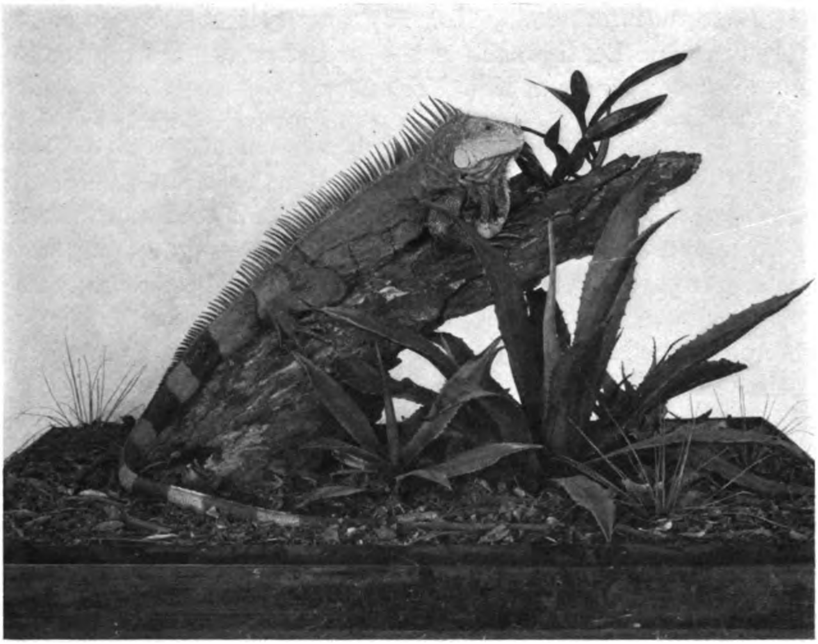
A SELECTION of some of the most striking material from the rich Museum collection from the South Sea Islands has been installed in the West Tower room opening off from the Siberian Hall. This is merely a suggestion of the extensive series which will be placed on exhibition when space has been provided.

ON February 24, Professor W. M. Wheeler, Curator of Invertebrate Zoölogy, went to Porto Rico to study some phases of the insect fauna of that island and make collections for the Museum in connection with a botanical expedition under Professor N. L. Britton, Director of the Botanical Garden in Bronx Park

THE series of models in the Department of Invertebrate Zoölogy continues to grow. Among the new models may be mentioned those representing several kinds of rotifers, bryozoans and other forms A series of eleven models shows the development of the starfish from the most rudimentary embryo to the end of the tenth day, when the larval form is about to pass from the creeping into the free swimming stage. The class of Brachiopoda is now represented by a series of selected forms mounted in alcohol or formaldehyde.

THE Department of Geology has received a ten-foot section of a drill core from a depth of 170–180 feet below the new building at 176 Broadway. The specimen, which is of garnetiferous mica schist, is the gift of the Standard Plunger Elevator Co.

An interesting and valuable collection of Termites and nests from the Isthmus of Panama has been donated to the Museum by Mrs. A. Beaumont of Vineland, New Jersey, as a memorial of her husband, the late Joseph Beaumont, Esquire, who collected the specimens. The collection contains several thousand queens, males, workers and soldiers of several species of Termites, preserved in alcohol and mounted in balsam on slides, together with specimens of nests, Termite tunnels and a number of other insects inhabiting Termite nests.



THE IGUANA GROUP
Hall No. 207

Among groups which have been placed temporarily in the East Mammal Hall, No. 207 of the second floor, may be mentioned those of the Iguana, the large tropical lizard which was collected for the Museum in Sinaloa, Mexico, the great Texas Rattlesnake, which next to the Diamond Back is the largest and most dangerous of the poisonous snakes in the United States, collected near the mouth of the Rio Grande and the Mud-Turtle,

representing a familiar inhabitant of the fresh-water marshes and ponds of the United States. Several snakes have been mounted and placed for the time being in the cases near by.

THERE has been added to the William Schaus collection a series consisting of 1500 specimens of Lepidoptera from Cuba collected by Mr. Schaus himself.

A PLASTER cast of the large Leatherback Turtle which was presented to the Museum last summer by Messrs. G. M. Long & Co. of New London, Conn., has been installed temporarily in the East Mammal Hall, No. 207 of the second floor of the Museum. The Leatherback is the largest of the Marine reptiles found in the vicinity of New York City.

THE Department of Anthropology has recently received from the Blackfoot Indians a medicine bundle used in the annual sun-dance. These bundles are rather difficult to obtain because of their sacred character and the restrictions governing their transfer from one individual to another. For these reasons they make an unusually important addition to a museum collection. The sun-dance is usually given at the expense of some woman who, in time of great trial, makes a vow to the sun that if her prayer is granted she will secure one of the sacred bundles and give or bear the expense of the sun-dance during the following summer. The bundle contains a head-dress upon which are symbols of the lizard, the First Woman and the sacred turnip, together with the feathers of a number of birds. In addition, the bundle contains a sacred digging stick with which the First Woman dug up the sacred turnip in violation of the commands of the Sun, the result of which was her fall. In the bundle there are also seven different kinds of paint used to anoint the body; seven large rattles representing the seven stars, and numerous other smaller objects used in the ceremony. There is an elaborate ritual pertaining to the bundle containing about one hundred songs referring to the power of the Sun and of the First Woman who dug up the forbidden turnip. This bundle and its contents will be installed in the exhibit of the Plains Indians.

THERE has been placed in the west stairway between the

second and third floors, a peculiar exhibit consisting of four "pictures" to demonstrate the fact that the colors of birds agree in tint with the colors of their surroundings. Three of the pictures represent the Bluejay, the Woodpecker and the Bird of Paradise in their natural surroundings and are intended to prove the theory that animals' colors, if they remain unchanged throughout the year, represent the scene which forms their background at the season and for the eyes with which their lives are most concerned. They are striking illustrations of protective coloration. The fourth picture is a landscape made entirely of the feathers of the Bluejay. The exhibit has been gotten together by Mr. A. H. Thayer of Monadnock, N. H.

AN attractive exhibit which has recently been placed on view in the Chinese Hall, No. 301 of the gallery floor, is the mahogany bed of a Chinese nobleman. The woodwork is elaborately inlaid with carved ivory representing landscapes and conventional figures and is ornamented with delicate carvings and paintings on silk. This combined bed and anteroom is designed to stand like one of our ordinary bedsteads in the sleeping room of the owner.

A NEW group in the North American Hall, No. 102 on the ground floor, represents the summer home of the Eskimo of Cumberland Sound. The scene selected is the bringing home of the results of a successful seal-hunting expedition. This group is a companion piece to the group of the winter home of the same tribe.

THE naturally mummified body from the copper mine in Chile, popularly known as the "Copper Lady," has attracted thousands of visitors to the Peruvian Hall during the past four months. The specimen was described and illustrated in the January number of the JOURNAL.

THERE were more than three hundred lectures and scientific papers given at the Museum during the year 1905. The attendance at these was as follows: Members' courses, 10,485; Pupils' courses, 46,399; on the principal holidays, 3,762; Board of Education courses, 42,212; meetings of scientific societies, 2,688.

THE records show that 17,402 visitors attended the American Tuberculosis Exhibition which was held at the Museum from November 27 to December 9, 1905.

THE attendance at the Museum in the year 1905 was 565,489 visitors, a highly satisfactory increase over the attendance in 1904. The receipts from membership fees too were larger during the past year than ever before, amounting to $17,875.00.

ON account of the enforced absence of Professor Bickmore through illness, the afternoon lecture to the general public on Washington's Birthday was given by Mr. George H. Sherwood, of the Scientific Staff, and the Members' lectures on March 15 and 22 were delivered by Professor Robert W. Prentiss, of Rutgers College.

THE Collection of Birds of Paradise provided for through the generosity of a friend of the Museum has recently received several choice acquisitions through purchase.

LECTURES.

MEMBERS' COURSE.

THE second course of lectures for the season 1905 and 1906 to Members of the American Museum of Natural History was given during February and March. Programme:

February 15.—MR. HARLAN I. SMITH, "The Five American Nations: Conquerors of the Snow, Forest, Mist, Desert and Plain."

March 1.—MR. FRANK M. CHAPMAN, "Impressions of English Bird-Life."

March 8.—MR. BARNUM BROWN, "Travels in Patagonia."

March 15.—PROF. R. W. PRENTISS, "Meteors and Comets: Their Mutual Relations."

March 22.—PROF. R. W. PRENTISS, "The Planets: Their Telescopic Appearance and Physical Condition."

PUPILS' COURSE.

THE programme of the second course of lectures to the public school children for the season 1905 and 1906 is as follows:

	Mar.	Apr.	
Monday,	12,	2.	—MR. G. H. SHERWOOD, "Japan and her Neighbors."
Wednesday,	14,	4.	—MR. F. M. CHAPMAN, "Travels in the West Indies."
Friday,	16,	20.	—MR. R. W. MINER, "Animals of North America—Their Habits and Uses."
Monday,	19,	23.	—MR. G. H. PEPPER, "Life in California and the Great Southwest."
Wednesday,	21,	25.	—DR. E. O HOVEY, "The Region of the Great Lakes."
Friday,	23,	27.	—MR. G. H. SHERWOOD, "American Trees and their Products."
Monday,	26,	30.	—Mr. H. I. SMITH, " Hiawatha's People."
		May	
Wednesday,	28,	2.	—MR. G. H. SHERWOOD, "Historical Scenes in the Colonies."
Friday,	30,	4.	—Mr. R. W. MINER," Mediterranean Countries, Ancient and Modern."

Particulars regarding this course may be obtained by addressing the Director.

PEOPLE'S COURSE.

THE programme of the second course of Free Lectures to the People, which are given on Tuesday and Saturday evenings in co-operation with the Department of Education of the City of New York, is as follows:

Saturday evenings at 8 o'clock.

A course of nine lectures on Physics, illustrated by stereopticon views and experiments.

PROF. ERNEST R. VAN NARDROFF.

March 3.—"The Nature of Light and Color."
March 10.—"Spectrum Analysis and the Stars."
March 17.—"Color Photography."
March 24.—"The Optics of Painting."
March 31.—"The Colors of Polarized Light."
April 7.—"Colors from the Interference of Light."
April 14.—"The Relation of Light to Electricity."

April 21.—"Optical Illusions."

April 28.—Dr. Charles H. Tyndall, "Wireless Telegraphy."

Tuesday evenings at 8 o'clock.

March 6.—Mr. Oscar Phelps Austin, "A Tour of the World's Markets and Market Places."

March 13.—Mr. B. Bulkley, "The Yellowstone National Park."

March 20.—Prof. Herschel C. Parker, "First Ascents and Explorations in the Canadian Alps."

March 27.—Mr. A. H. Fish, "The Land of Lewis and Clark."

April 3.—Dr. C. F. Walker, "The Lake Superior Copper Country."

April 10.—Mr. James Arthur MacKnight, "The South To-day."

April 17.—Mr. William T. Dorward, "The City of Washington."

April 24.—Messrs. Albert Ulmann, R. P. Bolton, and Edward Hagaman Hall, "Historic Landmarks of New York City."

LINNÆAN SOCIETY COURSE.

In co-operation with the New York Linnæan Society a course of lectures was delivered on Wednesday evenings according to the following programme:

February 21.—Dr. Alfred G. Mayer, "Tortugas Marine Laboratory of the Carnegie Institution—its Aims and Problems."

March 7.—Mr. Edgar F. Stead, "New Zealand Bird-Life."

March 14.—Dr. Robert T. Morris, "A Naturalist's Camping Trip to Hudson Bay."

March 21.—Mr. G. Abbott, "Bird-Hunting with a Camera."

MEETINGS OF SOCIETIES.

The New York Academy of Sciences holds its regular meetings at 8:15 P.M. at the Museum in the following order:

First Mondays.—Business meeting and Section of Biology.

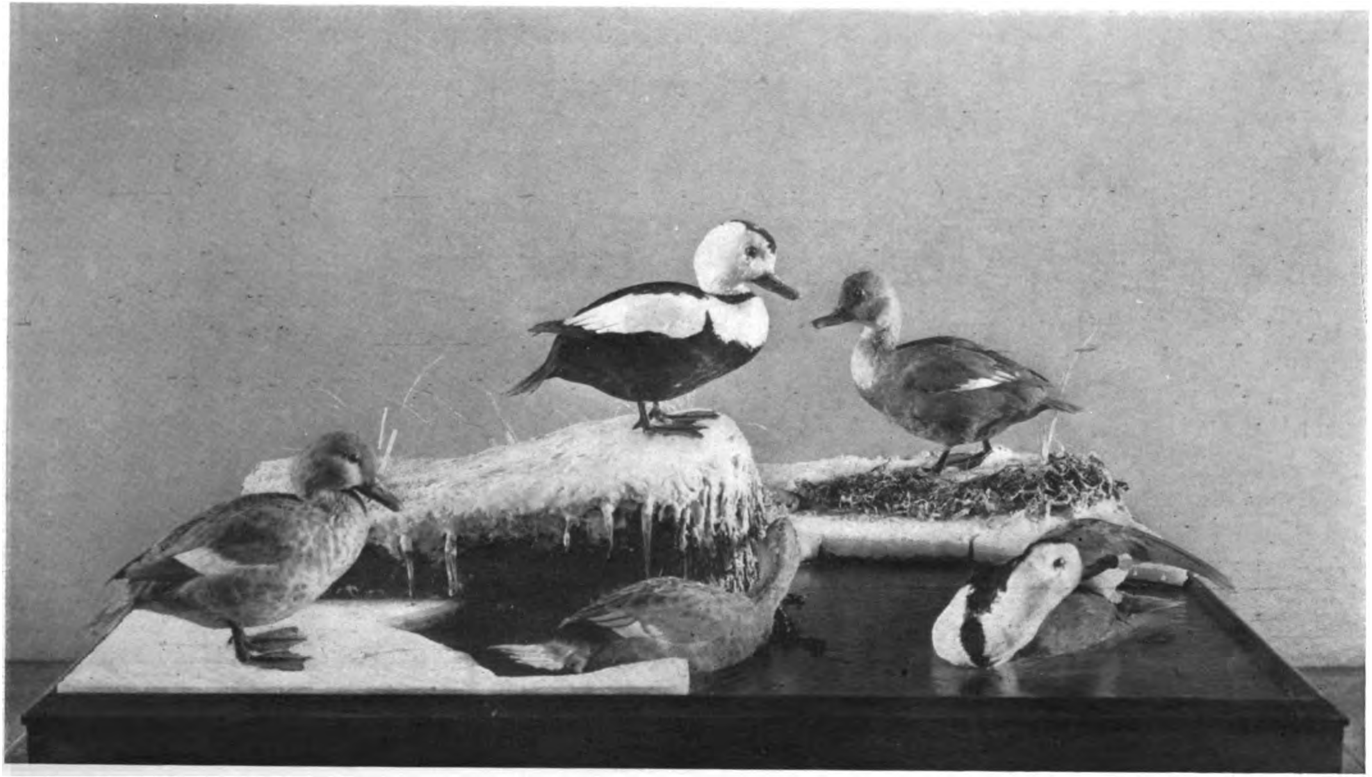
Second Mondays.—Section of Geology and Mineralogy.

Third Mondays.—Section of Astronomy, Physics and Chemistry.

Fourth Mondays.—Section of Anthropology and Psychology.

The Linnæan Society, the New York Entomological Society and the Torrey Botanical Club hold meetings upon Tuesday evenings, and the New York Mineralogical Club upon Wednesday evenings as announced.

The meetings of all the societies are open free to the public and visitors are made welcome.



THE LABRADOR DUCK
Group, Hall No. 208

THE BIRDS OF THE VICINITY OF NEW YORK CITY.[1]

By Frank M. Chapman.

Associate Curator of Mammalogy and Ornithology.

Introduction.

The collection which this Guide is intended to accompany has been formed especially to aid students in identifying the birds found in the vicinity of New York City. It occupies a portion of the West Corridor of the third floor (Hall No. 303). With a few exceptions, all the specimens contained in it were collected within 50 miles of the American Museum of Natural History. The species which we have as yet been unable to secure within these limits are represented temporarily by specimens from the North American Collection. The collection is placed under two heads: first, systematic, containing virtually all the birds which have been recorded from within the prescribed limits, and second, seasonal, in which only the birds of the month are exhibited, as is explained more fully beyond. Species of accidental occurrence, or those which have been found in this vicinity but once or twice, are grouped at the end of the systematic collection.

The birds are labeled in accordance with the system of nomenclature adopted by the American Ornithologists' Union. The number on the label, preceding the name of each species is its number in the Union's "Check-List" of North American birds (2nd edition, 1895). In the desk case in the center of the hall will be found a local collection of the nests and eggs of the birds which breed within 50 miles of the Museum. It is labeled on the same plan as the local collection of birds. Near by are placed photographs from nature of the nests of most of our breeding birds and exhibits of bills, feet, wings, tails and feathers designed to explain technical terms used in descriptive ornithology. A list of useful ornithological publications will also be found here.

[1] Issued also in separate form as **Guide Leaflet** No 22.

The appended annotated list of the species known to occur within a radius of 50 miles of the Museum is based on information derived for the most part from four sources: (1) previously published records; (2) the author's notes covering a period of twenty years' intermittent observation, mainly at Englewood, N. J.; (3) the observations of Mr. Waldron DeWitt Miller at Plainfield, N. J.; and (4) information received from Mr. William Dutcher. For many years Mr. Dutcher has made a specialty of the study of Long Island birds and has brought together a vast amount of data concerning them.

As a matter of local interest an asterisk (*) has been placed before those species which have been observed in Central Park. This list of Park birds is based on published records, the author's observations and information received from Messrs. C. G. Abbott, S. H. Chubb and B. S. Bowdish.

The text cuts with which this Guide is illustrated, with the exception of the Starling, are from Coues's "Key to North American Birds." For their use the Museum is indebted to Messrs. Dana Estes and Company, the publishers of that work. The full page plates are from photographs of Museum exhibits.

The region embraced within our limits possesses natural advantages calculated to attract a great number of birds. Our seacoast, with its sandy beaches and shallow bays; our rivers, creeks and ponds, with their surrounding grassy marshes; our wooded hillsides and valleys; our rolling uplands and fertile meadows, offer haunts suited to the wants of most birds. Again, our coastline and the Hudson River valley form natural highways of migration regularly followed by birds in their journeys to and from their summer homes.

The exceptional abundance of birds in this vicinity, however, is not due alone to the varied character of the country, or to the fact that twice each year streams of migrants pass along our coasts and through our valleys. There are certain causes which tend to limit the ranges of animals, chief among which is temperature. A study of the ranges or habitats of animals and plants shows that the boundaries of the areas inhabited by many species coincide with one another and also to a greater or less extent with lines of equal temperature. The ranges of these species being thus governed by natural causes, they are taken as indices of the limits of faunas or natural life-areas. The

lines between these faunas cannot, of course, be sharply drawn. The change from one to another is gradual, and between the two a neutral strip exists in which will be found species characteristic of each. Just such a condition is found in this vicinity, the northern boundary of the Carolinian Fauna over-lapping the southern boundary of the Alleghanian Fauna in the valleys of the Delaware, Hudson and Connecticut. In other words, we have here on the one hand a number of birds which are found no farther north and on the other certain species which are found no farther south; that is, in the breeding season, for among birds only the nesting ranges are of value in determining the boundaries of faunas.

The southern limit of the Carolinian Fauna on the Atlantic Coast is near Norfolk, Virginia; its northern limit, on the coast, as said above, is in the vicinity of New York City. To be more exact, a careful study of the nesting ranges of certain species shows that the most northern points at which they are regularly found is Port Jervis in the Delaware valley, Fishkill in the Hudson River valley, and Portland in the Connecticut River valley. These localities then may be considered as defining the northern limits of the Carolinian Fauna in the valleys in which they are placed. In the more elevated country between these points it is doubtful if the limits of the fauna reach quite as far north, for river valleys, both because they offer a natural pathway for the extension of a bird's range, and because of the higher temperature prevailing in them, tend to carry northward the boundaries of faunas. Eastward, along the Connecticut shore, the Carolinian Fauna may reach the mouth of the Thames. Long Island, although farther south, belongs for the most part in the Alleghanian rather than the Carolinian Fauna. Numbers of species common and even abundant in the Lower Hudson valley are exceedingly rare on Long Island, especially on the southern shore. But along the northern shore, or older part of the island, where deciduous trees abound, there is an evident trace of the Carolinian Fauna shown by the regular occurrence of the Blue-winged Warbler and the Acadian Flycatcher.

The following Carolinian birds are found every summer within 50 miles of the Museum, and all but two or three are known to nest regularly here. Their occurrence as breeding birds northward beyond these limits is, with but few exceptions, rare and irregular.

Clapper Rail.
King Rail.
Turkey Vulture.
Barn Owl.
Acadian Flycatcher.
Fish Crow.
Cardinal.
Rough-winged Swallow.
Worm-eating Warbler.
Blue-winged Warbler.
Louisiana Water-Thrush.
Kentucky Warbler.
Hooded Warbler.
Mockingbird.
Carolina Wren.
Tufted Titmouse.
Carolina Chickadee.
Blue-gray Gnatcatcher.

The southern limit of the Alleghanian Fauna on the coast is less clearly defined. It includes, however, Long Island and northern New Jersey. Its boundaries may be determined by the presence in the breeding season of the following species, few of which are known to nest at sea-level south of our limits:

Carolina Rail.
Alder Flycatcher.
Least Flycatcher.
Bobolink.
Savanna Sparrow.
Rose-breasted Grosbeak.
Purple Finch.
Golden-winged Warbler.
Nashville Warbler.
Chestnut-sided Warbler.
Black-throated Green Warbler.
Wilson's Thrush.

Thus it will be seen that while the region south of our district has the Carolinian species mentioned, and the region to the northward has the Alleghanian species just given, we, in this intermediate strip, have both Carolinian and Alleghanian species.

It is evident, therefore, that from an ornithological standpoint we are most favorably situated, and a comparison of the number of birds found within our limits with the numbers recorded from other districts shows that the causes mentioned have been effective in giving us an unusually rich avifauna. Due allowance must of course be made for the much greater area included in all but one of the regions used in comparison.

Recorded from within 50 Miles of New York City			353
"	"	District Columbia (Richmond, MS.)	281
"	"	Ontario, Canada, (McIlwraith)	316
"	"	Massachusetts (Howe and Allen)	362
"	"	Illinois (Ridgway)	352
"	"	Indiana (Butler)	305
"	"	Michigan (Cook)	332
"	"	Kansas (Goss)	343

During the course of a year the bird-life of our vicinity is subject to great changes. Some birds are always with us, some come for the summer, others pass us in the spring and fall in traveling to and from their more northern homes, and others still come

only in the winter. Our birds may thus be arranged, according to the season when they are present, in several rather well-defined groups, for which the following names seem most applicable.

I. Permanent Residents.—This class includes species which are with us throughout the year, but it does not follow that the same individuals pass the entire year here. Comparatively few, indeed, of the species in this group are permanent residents in the strict sense of the term. The Bob-white, Ruffed Grouse, and several of the Owls are doubtless literally permanent residents, that is, the same individuals pass their lives in one restricted locality, but it is not probable that the Bluebirds, for example, found here during the winter are the same birds which nested with us in the summer. Doubtless our winter Bluebirds pass the summer farther north, while our summer Bluebirds winter farther south but as a species, the Bluebird is a permanent resident.

List of Permanent Residents.

Bob-white.	Blue Jay.
Ruffed Grouse.	American Crow.
Marsh Hawk.	Fish Crow.
Sharp-shinned Hawk.	Starling.
Cooper's Hawk.	Meadowlark.
Red-tailed Hawk.	House Sparrow.
Red-shouldered Hawk.	Purple Finch.
Broad-winged Hawk.	American Goldfinch.
Bald Eagle.	European Goldfinch.
Duck Hawk.	Song Sparrow.
Sparrow Hawk.	Swamp Sparrow.
Long-eared Owl.	Cardinal.
Barred Owl.	Cedar Waxwing.
Screech Owl.	Carolina Wren.
Great Horned Owl.	White-breasted Nuthatch.
Hairy Woodpecker.	Tufted Titmouse.
Downy Woodpecker.	Chicadee.
Flicker.	Robin.

Bluebird.

II. Summer Residents.—Summer residents, as the name implies, are birds found here during the summer. They may, however, arrive early in March and remain until December, as do the Blackbirds and the Woodcocks, or they may not come until May and may leave us in August. Summer residents, then, are birds which come to us at varying times in the spring and after nesting here return to more southern winter resorts in the fall.

List of Summer Residents.

Wood Duck.
American Bittern.
Least Bittern.
Green Heron.
Black-crowned Night Heron.
King Rail.
Clapper Rail.
Virginia Rail.
Sora.
Yellow Rail.
Black Rail.
Woodcock.
Bartramian Sandpiper.
Spotted Sandpiper.
Kildeer.
Piping Plover.
Mourning Dove.
Osprey.
Barn Owl.
Yellow-billed Cuckoo.
Black-billed Cuckoo.
Belted Kingfisher.
Red-headed Woodpecker.
Whip-poor-will.
Nighthawk.
Chimney Swift.
Ruby-throated Hummingbird.
Kingbird.
Crested Flycatcher.
Phœbe.
Wood Pewee.
Acadian Flycatcher.
Alder Flycatcher.
Least Flycatcher.
Bobolink.
Cowbird.
Red-winged Blackbird.
Orchard Oriole.
Baltimore Oriole.
Purple Grackle.
Vesper Sparrow.
Savanna Sparrow.
Grasshopper Sparrow.
Henslow's Sparrow.
Sharp-tailed Sparrow.
Seaside Sparrow.
Chipping Sparrow.
Field Sparrow.
Towhee.
Rose-breasted Grosbeak.
Indigo Bunting.
Scarlet Tanager.
Purple Martin.
Cliff Swallow.
Barn Swallow.
Tree Swallow.
Bank Swallow.
Rough-winged Swallow.
Red-eyed Vireo.
Warbling Vireo.
Yellow-throated Vireo.
White-eyed Vireo.
Black and White Warbler.
Worm-eating Warbler.
Blue-winged Warbler.
Golden-winged Warbler.
Parula Warbler.
Yellow Warbler.
Chestnut-sided Warbler.
Black-throated green Warbler.
Pine Warbler.
Prairie Warbler.
Ovenbird.
Louisiana Water-Thrush.
Kentucky Warbler.
Maryland Yellow-throat.
Yellow-breasted Chat.
Hooded Warbler.
Redstart.
Catbird.
Brown Thrasher.
House Wren.
Short-billed Marsh Wren.
Long-billed Marsh Wren.
Wood Thrush.
Wilson's Thrush.

III. Summer Visitants.—Comparatively few birds fall into this group. As a rule the northern limit of their breeding range is not far south of our southern boundaries and they sometimes

visit us in small numbers, generally after their breeding season is over. In this group may also be placed the Shearwaters and Petrels, some of which are known to nest in the Antarctic Regions during our winter. In the spring they migrate northward and pass the summer off our coasts.

List of Summer Visitants.

Gull-billed Tern.
Royal Tern.
Forster's Tern.
Sooty Tern.
Black Skimmer.
Greater Shearwater.
Audubon's Shearwater.
Sooty Shearwater.
Wilson's Petrel.
American Egret.
Little Blue Heron.
Wilson's Plover.
Oyster-catcher.
Turkey Vulture.
Red-bellied Woodpecker.
Summer Tanager.
Carolina Chickadee.
Blue-gray Gnatcatcher.
Mockingbird.

IV. Winter Residents.—Winter residents, like summer residents, may arrive long before and remain long after the season which gives them their name. Our Junco, or Snowbird, for example, comes from the north in September and remains until April, but is a typical winter resident. That is, it arrives in the fall and after passing the entire winter with us returns to its more northern summer home in the spring.

List of Winter Residents.

Holbœll's Grebe.
Horned Grebe.
Loon.
Red-throated Loon.
Razor-billed Auk.
Kittiwake Gull.
Glaucous Gull.
Great Black-backed Gull.
Herring Gull.
Ring-billed Gull.
Green-winged Teal.
American Golden-eye.
Buffle-head.
Old-Squaw.
King Eider.
American Scoter.
White-winged Scoter.
Surf Scoter.
Purple Sandpiper.
Rough-legged Hawk.
Saw-whet Owl.
Horned Lark.
Prairie Horned Lark.
American Crossbill.
Redpoll.
Pine Siskin.
Snowflake.
Lapland Longspur.
Ipswich Sparrow.
White-throated Sparrow.
Tree Sparrow.
Junco.
Northern Shrike.
Myrtle Warbler.
Winter Wren.
Brown Creeper.
Canadian Nuthatch.
Golden-crowned Kinglet.

V. Winter Visitants.—Winter visitants are birds which may or may not visit us during the winter. As a rule, their presence

depends upon the severity of the winter. An unusually severe season sometimes forces boreal birds southward and they then may be found in numbers south of their regular winter range.

List of Winter Visitants.

Puffin.	American Eider.
Black Guillemot.	Goshawk.
Brunnich's Murre.	Black Gyrfalcon. (?)
Dovekie.	Hawk Owl.
Iceland Gull.	Snowy Owl.
Kumlien's Gull.	Evening Grosbeak.
Cormorant.	Pine Grosbeak.
Harlequin Duck.	White-winged Crossbill.

Holbœll's Redpoll.

VI. Regular Transient Visitants.—The birds of this class are found here only during the migrations. Their summer homes are north of us, their winter homes are south of us, and we see them only when they pass northward on their spring migration and southward on their fall migration.

List of Regular Transient Visitants.

Pied-billed Grebe.	Tennessee Warbler.
Pomarine Jaeger.	Cape May Warbler.
Parasitic Jaeger.	Black-throated Blue Warbler.
Long-tailed Jaeger.	Dowitcher.
Laughing Gull.	Long-billed Dowitcher.
Bonaparte's Gull.	Stilt Sandpiper.
Common Tern.	Knot.
Roseate Tern.	Pectoral Sandpiper.
Caspian Tern.	White-rumped Sandpiper.
Cory's Shearwater.	Least Sandpiper.
Leach's Petrel.	Red-backed Sandpiper.
Gannet.	Semipalmated Sandpiper.
Double-crested Cormorant.	Western Sandpiper.
Red-breasted Merganser.	Sanderling.
Hooded Merganser.	Greater Yellow-legs.
Black Duck.	Yellow-legs.
Blue-winged Teal.	Solitary Sandpiper.
Pintail.	Willet.
Redhead.	Hudsonian Curlew.
American Scaup Duck.	Black-bellied Plover.
Lesser Scaup Duck.	Golden Plover.
Ruddy Duck	Semipalmated Plover.
Canada Goose.	Turnstone.
Brant.	Pigeon Hawk.
Great Blue Heron.	Short-eared Owl.
Florida Gallinule.	Yellow-bellied Woodpecker.
Coot.	Magnolia Warbler.
Red Phalarope.	Bay-breasted Warbler.

Northern Phalarope.
Wilson's Snipe.
Olive-sided Flycatcher.
Yellow-bellied Flycatcher.
Rusty Blackbird.
Bronzed Grackle.
Nelson's Sharp-tailed Sparrow.
Acadian Sharp-tailed Sparrow.
White-crowned Sparrow.
Lincoln's Sparrow.
Fox Sparrow.
Philadelphia Vireo.
Blue-headed Vireo.
Nashville Warbler.
Black-poll Warbler.
Blackburnian Warbler.
Palm Warbler.
Yellow Palm Warbler.
Water-Thrush.
Connecticut Warbler.
Mourning Warbler.
Wilson's Warbler .
Canadian Warbler.
Titlark.
Ruby-crowned Kinglet.
Gray-cheeked Thrush.
Bicknell's Thrush.
Swainson's Thrush.
Hermit Thrush.

VII. Irregular Transient Visitants.—These birds occur irregularly during the migrations. With certain exceptions they are birds of the interior and breed in the northern United States and British Provinces. Their regular line of migration is down the Mississippi Valley, and their occurrence on the Atlantic coast is more or less infrequent. Here are also included species formerly common near New York, but now practically extinct within our limits, where, however, they are sometimes found.

List of Irregular Transient Visitants.

Least Tern.
Black Tern.
Mallard.
Gadwall.
American Widgeon.
Shoveller.
Canvasback.
Ring-necked Duck.
Greater Snow Goose.
Blue Goose.
American White-fronted Goose.
Hutchins's Goose.
Black Brant.
Whistling Swan.
Wilson's Phalarope.
American Avocet.
Baird's Sandpiper.
Marbled Godwit.
Hudsonian Godwit.
Buff-breasted Sandpiper.
Long-billed Curlew.
Eskimo Curlew.
Passenger Pigeon.
Golden Eagle.
Migrant Shrike.
Orange-crowned Warbler.
Grinnell's Water-Thrush.

VIII. Accidental Visitants.—The homes of the birds included in this class are so far removed from our boundaries that their presence here at any time can be considered only as purely accidental. In most cases it is doubtless due to the agency of storms or high winds which drive migrating birds from their course. One-fourth the number given below are Old World birds, and about one-half the total number have been found here but once.

List of Accidental Visitants.

Black-throated Loon.	Ground Dove.
Ivory Gull.	Black Vulture.
Little Gull.	Swallow-tailed Kite.
Sabine's Gull.	Swainson's Hawk.
Fulmar.	White Gyrfalcon.
Booby.	Great Gray Owl.
White Pelican.	Red-cockaded Woodpecker.
Brown Pelican.	Pileated Woodpecker.
European Widgeon.	Arkansas Kingbird.
European Green-winged Teal.	Raven.
Rufous-crested Duck.	Chestnut-collared Longspur.
Barnacle Goose.	Lark Sparrow.
White Ibis.	Blue Grosbeak.
Glossy Ibis.	Painted Bunting.
Snowy Heron.	Dickcissel.
Yellow-crowned Night Heron.	Louisiana Tanager.
Corn Crake.	Bohemian Waxwing.
Purple Gallinule.	Prothonotary Warbler.
Black-necked Stilt.	Cerulean Warbler.
European Woodcock.	Yellow-throated Warbler.
Curlew Sandpiper.	Townsend's Solitaire.
Ruff.	Varied Thrush.
Lapwing.	Wheatear.

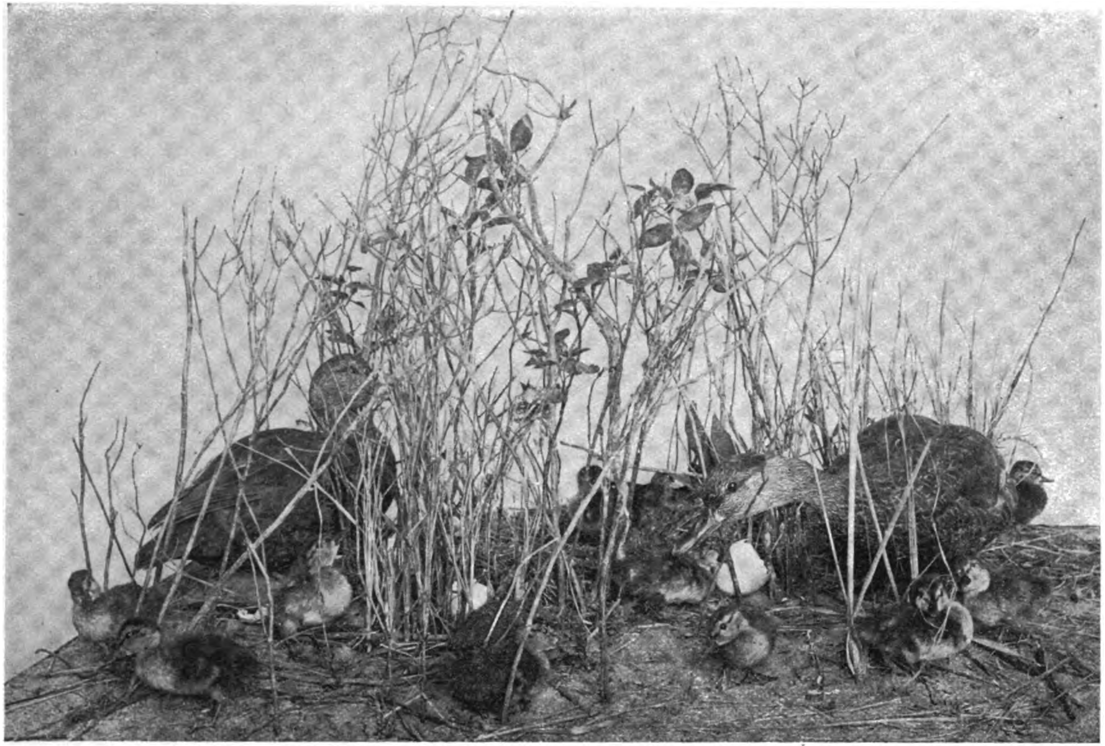
Summary.

Permanent Residents	34
Summer Residents	86
Summer Visitants	19
Winter Residents	38
Winter Visitants	17
Regular Transient Visitants	86
Irregular Transient Visitants	27
Accidental Visitants	46
Total,	353

THE SEASONAL COLLECTION.

The preceding seasonal analysis of our avifauna shows that only a part of the 353 birds which have been recorded from this vicinity are present at one time, and any arrangement of specimens which will, for example, show only the birds of a given month, will of course greatly simplify the problem of identification by excluding from it all species which, for seasonal reasons, we should not expect to find during the month in question.

The Seasonal Collection is made up of the Permanent Residents (Cases Q and O) and Migrants (Case P) and is changed



BLACK DUCK
Group, Hall No. 208

each month. Thus, in February, it is composed of the ever-present Permanent Residents together with the migrants which have come from the north to spend the winter. In March, the March migrants from the south are added, and a month later those which may be expected to arrive in April are included. In due time the winter birds are withdrawn and the transient migrants removed, until in June, the collection consists of the Permanent Residents and birds which have come from the south to spend the summer. A similar treatment is continued throughout the year and the collection always, therefore, represents the bird-life of the month in which it is seen.

The following outline of the bird-life of the year explains more fully the manner in which this Seasonal Collection is arranged, and at the same time, it may be used as a reference check-list in the study of local migration. It should be understood that the dates given represent those of a climatically normal year and that only the commoner water birds are included.

January Bird-Life.—Probably during no other month is there less movement among our birds than in January. The regular winter visitants have come; the fall migrants which may have lingered until December have gone, and the earliest spring migrants will not arrive before the latter part of February or in early March. In fact, January is the only month in the year in which, as a rule, some birds do not arrive or depart. This rule, however, may be broken by such irregular birds as the Pine Grosbeak and the Redpoll, and, south of New York, the Snowflake and the Crossbill, birds which may be wholly absent some winters and abundant others.

The only birds usually to be found in January, therefore, are the permanent residents and the regular winter visitants. Singing, mating, nesting, molting, migrating, events which in their season play so important a part in a bird's life, do not concern the birds of January. With them food is the one important question, and their movements at this season are governed solely by the food supply. Snow may fall and winds blow, but as long as the birds find enough to eat they give small heed to the weather. Food, therefore, rather than temperature, is the most important factor in a bird's life at this season.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.
Winter Residents, see page 87.

February Bird-Life.—The conditions prevailing in the bird

world during January will be practically unchanged until the latter part of February. Then, should there be a period of mild weather, we may expect to hear the Song Sparrows and Bluebirds inaugurate the season of song. An unusually warm day earlier in the month may have tempted either or both of these birds prematurely to welcome spring, but as a rule we do not hear them until late in February, and then only under favorable conditions.

The songs of these birds bid us keep watch for the earlier migrants, the Robin, the Purple Grackle and the Red-winged Blackbird, birds which pass the winter such a short distance south of us that they appear at the first sign of returning spring. Further confidence in the growth of the new year is shown by the Great Horned Owl, one of our less common species, which begins nesting late in February or early in March.

In spite of these movements among the birds, February is, generally speaking, a winter month, and it is only in exceptional years that we find much change in our bird-life.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.

Winter Residents, see page 87.

Migrants arriving from the South.

February 15 to 28, in favorable seasons.

Purple Grackle.	Red-winged Blackbird.
Rusty Blackbird.	Robin.

March Bird-Life.—Although March is sure to witness a general northward movement among the birds, the date of their arrival is as uncertain as the weather of the month itself. Continued severe weather prevents an advance, which a higher temperature occasions. It is well, therefore, to watch the weather predictions, since birds will quickly follow in the wake of a warm wave.

When the ice leaves our bays, ponds and rivers, Ducks and Geese will appear. Even before this event, the Grackles, Red-winged Blackbirds and Robins will come in flocks and in song, and singing will become general with the Song Sparrows and Bluebirds, whose numbers will be greatly increased. When successive thaws have rendered the earth soft enough for the Woodcock's probe, we may expect to find him in favorable localities searching for his fare of earthworms. With the advent of insects, we may look for their enemy the Phœbe, and Meadowlarks, Cowbirds and other March Migrants may be found.

The weather which hastens the arrival of birds from the

South, also prompts certain of our Winter Visitants to begin their northward journey, and after March we do not often see Redpolls, Snowflakes or Northern Shrikes.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.

Winter Residents, see page 87.

Winter Residents leaving for the North.

Horned Lark.	Snowflake.
Redpoll.	Pine Grosbeak.

Northern Shrike.

Migrants arriving from the South.

Appearing when the ice leaves the bays and rivers.

Loon.	Green-winged Teal.
Pintail.	Blue-winged Teal.
Mallard.	Canada Goose.

March 1 to 10.

Purple Grackle.	Rusty Blackbird.
Red-winged Blackbird.	Robin.

March 10 to 20.

Woodcock.	Meadowlark.
Phœbe.	Cowbird.

Fox Sparrow.

March 20 to 31.

Wilson's Snipe.	Mourning Dove.
Kingfisher.	Swamp Sparrow.

White-throated Sparrow.

April Bird-Life.—In early April the developments in the vegetable world, which the most casual observer cannot fail to see, are accompanied by corresponding but less noticed activities in the world of birds. The appearance of the skunk-cabbage, the blossoming of the pussy-willow and the early wild flowers soon become common knowledge; but the arrival of the Vesper, Field and Chipping Sparrows, of Tree Swallows, Myrtle Warblers and Hermit Thrushes, is known to comparatively few. Still, to the bird-lover, the return of these feathered friends is of even greater interest than the blossoming of trees and plants.

The migratory movement grows rapidly in strength, and during the latter part of the month one may expect to see newcomers almost daily. It will be noted that the earlier migrants of the month are all seed-eaters, while the later are certain insectivorous birds which catch their prey in the air, for example, Swallows, Swifts and Nighthawks.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.

Winter Residents, see page 87.

Winter Residents leaving for the North.

Junco.	Brown Creeper.
Tree Sparrow.	Red-breasted Nuthatch.
Winter Wren.	Golden-crowned Kinglet.

Migrants arriving from the South.

April 1 to 10.

Pied-billed Grebe.	Field Sparrow.
Great Blue Heron.	Chipping Sparrow.
Black-crowned Night Heron.	Tree Swallow.
Osprey.	Myrtle Warbler.
Vesper Sparrow.	American Pipit.
Savanna Sparrow.	Hermit Thrush.

April 10 to 20.

American Bittern.	Barn Swallow.
Green Heron.	Yellow Palm Warbler.
Clapper Rail.	Pine Warbler.
Yellow-bellied Sapsucker.	Louisiana Water-Thrush.

Ruby-crowned Kinglet.

April 20 to 30.

Spotted Sandpiper.	Purple Martin.
Semipalmated Sandpiper.	Cliff Swallow.
Whip-poor-will.	Bank Swallow.
Chimney Swift.	Rough-winged Swallow.
Least Flycatcher.	Black and White Warbler.
Towhee.	Black-throated Green Warbler.
Blue-headed Vireo.	Brown Thrasher.

May Bird-Life.—As the season advances, marked changes in temperature are less likely to occur, and the migration becomes regular and continuous. In February and March there may be two weeks or more variation in the times of arrival of the same species in different years: in May we expect to find a given species within a day or two of a certain date. We shall, nevertheless, find the force of the migratory current still closely dependent on the weather, and under the encouragement of a high temperature we may be visited by "bird waves," flooding the woods with migrants. Birds are then doubtless more abundant than at any other season. As many as ten species may be noted as arriving on the same day, and sixty or seventy species may be observed within a few hours.

After May 15, birds begin to decrease in number, the Transient Visitants passing farther north, and by June 5 we have only Permanent Residents and Summer Residents.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.
Summer Residents, see page 86.

Migrants arriving from the South.

May 1 to 10.

Common Tern.
Solitary Sandpiper.
Semipalmated Plover.
Yellow-billed Cuckoo.
Black-billed Cuckoo.
Nighthawk.
Ruby-throated Hummingbird.
Crested Flycatcher.
Kingbird.
Baltimore Oriole.
Orchard Oriole.
Bobolink.
Grasshopper Sparrow.
Indigo Bunting.
Rose-breasted Grosbeak.
Scarlet Tanager.
Red-eyed Vireo.
Warbling Vireo.
Yellow-throated Vireo.
White-eyed Vireo.
Nashville Warbler.
Blue-winged Warbler.
Parula Warbler.
Black-throated Blue Warbler.
Magnolia Warbler.
Yellow-breasted Chat.
Chestnut-sided Warbler.
Prairie Warbler.
Small-billed Water-Thrush.
Hooded Warbler.
Yellow Warbler.
Maryland Yellowthroat.
Oven-bird.
Redstart.
House Wren.
Catbird.
Wood Thrush.
Veery.

May 10 to 20.

Wood Pewee.
Acadian Flycatcher.
Yellow-bellied Flycatcher.
White-crowned Sparrow.
Golden-winged Warbler.
Tennessee Warbler.
Worm-eating Warbler.
Cape May Warbler.
Blackburnian Warbler.
Bay-breasted Warbler.
Black-poll Warbler.
Wilson's Warbler.
Canadian Warbler.
Long-billed Marsh Wren.
Short-billed Marsh Wren.
Olive-backed Thrush.
Gray-cheeked Thrush.
Alder Flycatcher.
Mourning Warbler.
Bicknell's Thrush.

June Bird-Life.—After June 5 we may be reasonably sure that, with a few exceptions, every bird seen has or has had a nest in this vicinity. Several of the birds which began nesting in April will rear second broods in June, while the young of other April-nesting birds may not leave the nest until June. All the birds that began nesting in May will still be occupied with household affairs in June, and when we add to these the late-breeding species that wait for June before settling their domestic arrangements, it will be seen that among birds June is the home month of the year.

Nest-building, egg-laying, incubating and the care of the young now make constant and exceptional demands on birds which, in response, exhibit traits which at other times of the year they give no evidence of possessing. Singing now reaches its highest

development, and certain call-notes are heard only at this season. The numberless actions incident to courtship, the intelligence displayed in nest-building, the choice of special food for the young, the devotion which prompts the parents recklessly to expose themselves in protecting their offspring,—all these manifestations of the bird-mind may be observed in June.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.
Summer Residents, see page 86.

July Bird-Life.—The full development of the bird year is attained in June, and as early as the first week in July the season begins to wane, when, among some migratory birds, there are evidences of preparation for the journey southward.

The young of certain species which rear but one brood a year have now left the nest, and, accompanied by the parents, wander about the country. In localities which we had thoroughly explored in June, we may now find species not met with then. In some cases these families join others of their kind, forming small flocks, the nuclei of the great gathering seen later. Examples are Grackles, Red-winged Blackbirds and Tree Swallows. The last named increase rapidly in number, and by July 10 we may see them flying over late each afternoon *en route* to their roosts in the Hackensack marshes.

During the first week in the month we shall also find that certain birds have concluded their season of song. Bobolinks and Red-winged Blackbirds are rarely heard after the 10th of the month; their young are reared, the cares of nesting-time are passed, and with other one-brooded birds they begin to renew their worn breeding plumages by molting. After the 15th we miss the voices of the Veery, Orchard and Baltimore Orioles, Chat, Brown Thrasher and other birds.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.
Summer Residents, see page 86.

August Bird-Life.—With the majority of our nesting birds, family cares are ended in August, and at this season they completely renew their worn plumages by molting. When molting, birds are less in evidence than at any other time. What becomes of many of our birds in August it is difficult to say. Baltimore Orioles, for example, are rarely seen from August 1 to 20, but after the latter date they reappear clad in full plumage, and they are then in nearly full

song. So apparently complete is the disappearance of birds in August, that before the fall migration brings new arrivals daily from the north, one may spend hours in the woods and hear only the Red-eyed Vireo and the Wood Pewee, August's own songsters.

Late in the month, migrants from the north travel through the woods in small companies, but the characteristic bird-life of August is in the marshes. There the Swallows come in increasing numbers to their roosts in the reeds, while Red-winged Blackbirds and Bobolinks, under the alias of Reedbird, are abundant where the wild rice grows.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.
Summer Residents, see page 86.
Migrants arriving from the North.

August 1 to 15.

Sora.	Golden-winged Warbler.
Semipalmated Sandpiper.	Chestnut-sided Warbler.
Semipalmated Plover.	Canadian Warbler.
Yellow-bellied Flycatcher.	Small-billed Water-Thrush.

August 15 to 31.

Olive-sided Flycatcher.	Black-throated Green Warbler.
Tennessee Warbler.	Black-throated Blue Warbler.
Nashville Warbler.	Magnolia Warbler.
Parula Warbler.	Blackburnian Warbler.
Cape May Warbler.	Wilson's Warbler.

Red-breasted Nuthatch.

September Bird-Life.—The student whose patience has been sorely tried by the comparative scarcity of birds in August will find that in September his observations in the field will be attended by far more interesting results. The first marked fall in the temperature is sure to be followed by a flight of migrants which, like the "bird waves" of May, will flood the woods with birds. By far the larger number will be Warblers; indeed, September, like May, is characterized by the abundance of these small birds.

Birds of the year will outnumber the adults, and in most cases their plumage will be quite unlike that worn by their parents in May. In many instances, even the adults themselves appear in a changed dress. As a rule, fall plumages are less striking than those of spring, and when, in addition, it is remembered that birds are not in song, and that the foliage is much denser, the greater difficulty of identifying birds in the field will be appreciated.

About September 25 our more common Winter Visitants arrive from the north, but afterward birds decrease rapidly in number.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.

Summer Residents, see page 86.

Summer Residents leaving for the South.

September 1 to 10.

Acadian Flycatcher.
Orchard Oriole.
Rough-winged Swallow.
Worm-eating Warbler.
Blue-winged Warbler.

September 10 to 20.

Baltimore Oriole.
Purple Martin.
Yellow Warbler.
Yellow-breasted Chat.

September 20 to 30.

Common Tern.
Green Heron.
Hummingbird.
Kingbird.
Crested Flycatcher.
Wood Pewee.
Rose-breasted Grosbeak.
Yellow-throated Vireo.
Warbling Vireo.
Hooded Warbler.
Louisiana Water-Thrush.
Veery.

Migrants arriving from the North.

September 1 to 10.

Lincoln's Sparrow.
Black-poll Warbler.
Connecticut Warbler.

September 10 to 20.

Wilson's Snipe.
Blue-headed Vireo.
Olive-backed Thrush.
Bicknell's Thrush.

September 20 to 30.

Herring Gull.
Green-winged Teal.
Blue-winged Teal.
American Coot.
Junco.
White-throated Sparrow.
White-crowned Sparrow.
Myrtle Warbler.
Yellow Palm Warbler.
Brown Creeper.
Golden-crowned Kinglet.
Ruby-crowned Kinglet.
Winter Wren.
Gray-cheeked Thrush.

October Bird-Life.—Early October generally brings the first killing frost, depriving insectivorous birds of a large part of their food and forcing them to journey southward. Flycatchers, Warblers, Vireos and Swallows now take their departure, and after the 15th of the month few insect-eating birds remain, except those which, like Woodpeckers, feed on insect's eggs or larvæ.

This is the season of Sparrows. In countless numbers they throng old stubble, potato and corn fields, doing untold good by destroying the seeds of noxious weeds. With these birds will be the lately arrived Juncos, Tree Sparrows and Fox Sparrows. When disturbed, all seek shelter in the nearest hedgerow, and their mingled notes produce a twittering chorus in which it is difficult to distinguish the voices of individual birds.

This, however, will not be the only bird music of the month. Certain species now have a brief second song period, and on the brighter days of the month we may hear Song, White-throated and Fox Sparrows, Phœbes and Ruby-crowned Kinglets singing.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.
Summer Residents, see page 86.

Summer Residents leaving for the South.

October 1 to 10.

Black-crowned Night Heron.
Yellow-billed Cuckoo.
Black-billed Cuckoo.
Chimney Swift.
Least Flycatcher.
Bobolink.
Grasshopper Sparrow.
Indigo Bunting.
Scarlet Tanager.
Cliff Swallow.
Barn Swallow.
Bank Swallow.
White-eyed Vireo.
Black and White Warbler.
Oven-bird.
Redstart.
Wood Thrush.

October 10 to 20.

Spotted Sandpiper.
Whip-poor-will.
Nighthawk.
Red-eyed Vireo.
Maryland Yellowthroat.
Catbird.
Brown Thrasher.
House Wren.
Short-billed Marsh Wren.
Long-billed Marsh Wren.

October 20 to 31.

Pied-billed Grebe.
Phœbe.
Towhee.
Tree Swallow.

Migrants arriving from the North.

October 1 to 10.

Loon.
Pintail.
Mallard.
Canada Goose.
Bronzed Grackle.
Rusty Blackbird.
American Pipit.
Hermit Thrush.

October 10 to 20.

Fox Sparrow.

October 20 to 31.

Horned Lark.
Pine Finch.
Tree Sparrow.
Snowflake.
Redpoll.
Northern Shrike.

November Bird-Life.—It is an interesting fact that the last migrants to leave in the fall are the first to arrive in the spring. The bird-life of November, when the fall migration is practically concluded closely resembles, therefore, that of March, when spring migration is inaugurated. The reason for this similarity is to be found in the fact that both months furnish birds with essentially the same kind of food. Thus the Loon, Grebes, Ducks, Geese and

Kingfisher remain until the forming of ice in November or early December deprives them of food and forces them to seek open water; while Woodcock and Snipe linger until they can no longer probe the frost-hardened earth. The thaws of March, however, will bring all these birds back to us by restoring their food. Certain Sparrows stay with us until the weed-bearing seeds on which they feed are covered by snow, when they are compelled to retreat farther southward, only to return, however, when the March sun lays bare the earth. Few birds' songs are heard in November. In some sheltered spot Song and White-throated Sparrows may continue in voice, but the characteristic bird-note of the month is the scatter-call or fall whistle of Bob-White.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.

Migrants leaving for the South.

Wood Duck.	Cowbird.
American Bittern.	Red-winged Blackbird.
Great Blue Heron.	Purple Grackle.
Woodcock.	Vesper Sparrow.
Mourning Dove.	Chipping Sparrow.
Belted Kingfisher.	Field Sparrow.

Swamp Sparrow.

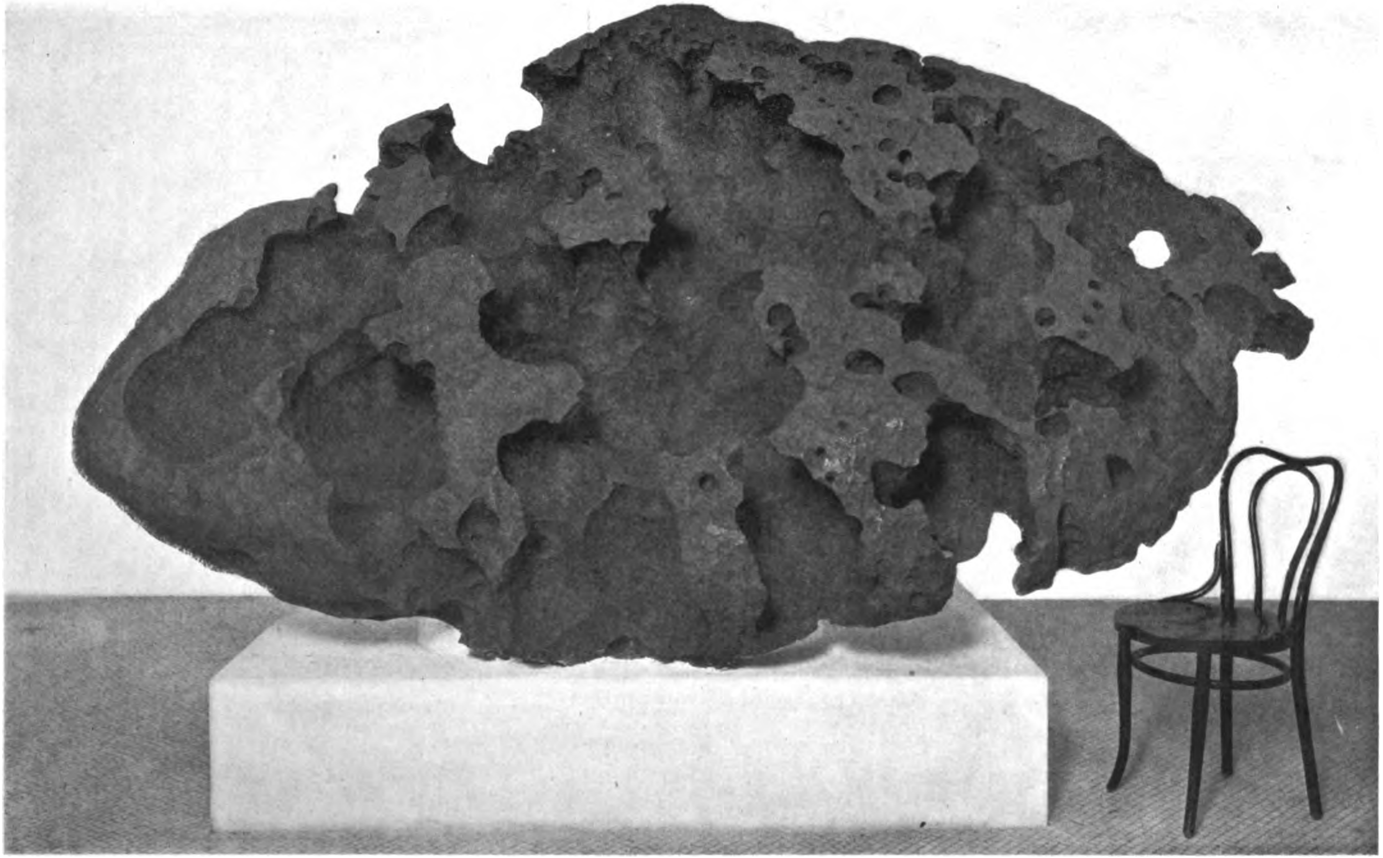
December Bird-Life.—The character of the bird-life of December depends largely upon the mildness or severity of the season. Should the ponds and streams remain open, the ground be unfrozen and little or no snow fall, many of the migrant species of November will linger into December.

The comparative scarcity of food now forces birds to forage actively for provisions, and when a supply is found, they are apt to remain until it is exhausted. Their wanderings in search of food lead them over large areas, and our dooryards and orchards may often be visited by species which, when food is more abundant, do not leave their woodland haunts. An excellent means of attracting them is to provide suitable food. Crumbs and seeds scattered in some place where they will not be covered by snow or blown away will bring Juncos and Tree Sparrows; an old seed-filled sunflower head may prove a feast for Goldfinches, while bits of meat, suet or ham bone hung from a tree will be eagerly welcomed by Chickadees, Nuthatches and Downy Woodpeckers.

BIRDS OF THE MONTH.

Permanent Residents, see page 85.

Winter Residents, see page 88.



THE WILLAMETTE METEORITE

Gift of Mrs. William E. Dodge

Length 10 feet, height 6 feet 6 inches, weight 15.6 tons

Rear side, showing deep pits formed by oxidation

The American Museum Journal

Vol. vi. JULY, 1906. No. 3

THE WILLAMETTE METEORITE.

THE Museum is particularly fortunate in having secured, as a gift from Mrs. William E. Dodge, the Willamette Meteorite, the largest meteorite which has been found in the United States and one of the three largest known. The great hollows and deep pits which characterize the surface of the mass combine with its enormous size to make this the most remarkable and interesting meteorite known.

Willamette is a siderite, or a mass composed of an alloy of iron and nickel, and its chief dimensions are: length, 10 feet; height, 6 feet 6 inches; thickness, 4 feet 3 inches; weight, as determined upon the railroad scales at Portland, Oregon, 31,107 pounds. About 100 pounds can safely be added to this weight for portions removed and carried away between its discovery and the time of its acquisition by the Museum, so that it is within bounds to say that the weight of the mass when found was at least 31,200 pounds, or about 15.6 tons.

All the great meteorites that are comparable with Willamette in size and weight are likewise siderites, or irons. They are Ahnighito, weighing 36.5 tons, Bacubirito, estimated at about 27.5 tons, the larger Chupaderos, 15.5 tons, San Gregorio, 11.1 tons, the smaller Chupaderos, 6.9 tons, and Bemdegó, 5.9 tons. Willamette's dimensions exceed those of the larger Chupaderos, and it therefore ranks as the third known meteorite in both size and weight.

Ahnighito, or "The Tent," is the largest of the three iron meteorites brought to New York from Cape York, Greenland, by Commander Robert E. Peary, U.S.N., and with its associates, the "Woman" (6,000 pounds) and the "Dog" (1,100 pounds), is at this Museum. Bacubirito lies where it fell ages ago near the spot where now is located the little village in the State of Sinaloa, Mexico, which gives it its name. The two Chupaderos irons,

the San Gregorio, the Concepcion (7,315 pounds) and two or three smaller masses, together aggregating about 41 tons in weight, are considered by some authorities to be portions of one fall, which occurred in prehistoric time in the southern portion of the State of Chihuahua, Mexico. They are known as the Huejuquilla group of meteorites, and they now occupy positions of honor in the collection of the National School of Mines in the City of Mexico. Bemdegó was found in Bahia, Brazil, in 1784 and is now in the National Museum in Rio de Janeiro.

Willamette has had a rather romantic history. It is reported that, in the autumn of 1902, Mr. Ellis Hughes and a man named Dale were prospecting for minerals in the forest adjoining the ranch of the former in the valley of the Tualitin, a stream flowing into the Willamette River about nineteen miles above (south of) the city of Portland, Oregon, when their hammers showed that a mass projecting a little above the ground was of metal, not rock. The prospectors soon learned that the mass was iron and later discovered that it was an isolated block and a meteorite instead of a "reef" upon which could be located a great mine, as they supposed at first. The exact location of the spot where the meteorite was found is Lat. 45° 22′ N., Long. 122° 35′ W. (Ward).

Messrs. Hughes and Dale kept their find a secret, hoping to be able to buy the land containing the meteorite. Not succeeding in acquiring the land, Mr. Dale left the country, but Mr. Hughes determined to get the meteorite by force, if not otherwise, and in August of 1903 set about the task of removing it to his own land about three-quarters of a mile distant through a dense forest. He had only his 15 year old son and a horse to assist him, but all were plucky and after three months of almost incessant labor with appliances of the crudest description (principally a capstan and wire cable and a truck made of logs) the big meteorite rested upon the soil of the Hughes ranch.

Then came publicity for the meteorite, and the Oregon Iron and Steel Company, the owners of the land upon which it fell, learned of its existence and removal from their property. Suit was immediately instituted for its recovery, and the case was carried to the Supreme Court of the State of Oregon before

THE WILLAMETTE METEORITE
Western half of front, or "Brustseite," showing fusion and erosion hollows and cylindrical bore-holes

Mr. Hughes was willing to abandon his efforts to retain the specimen. Title to the great iron was established late in the summer of 1905, and the mass was removed at once to the Mines Building of the Lewis and Clark Exposition at Portland, where it was an object of great attention from thousands of visitors during the closing weeks of the fair. Early in February of the present year the specimen was acquired for this Museum.

In general form Willamette may be described as a broad-based, low cone. When discovered the blunt apex of this cone was buried deepest in the ground, and the flatter, oval base was uppermost. Although the mass lay so long in the ground as to lose entirely its original exterior through oxidation, the probabilities are that the conical side of the mass was forward in its journey through space and our atmosphere. It is the side known to scientists as the "brustseite" of the meteorite, but it would be popularly called the front. The characteristics of the meteorite have been fully described by Henry A. Ward,[1] but the attention of the scientific public was first called to the mass, under the name of "Clackamas Meteoric Iron," by George F. Kunz.

The most striking characteristic of Willamette next to its size is the series of hollows and deep pits which indent its surface. These are of four kinds: broad shallow hollows on the front side, (the side now turned toward the wall); deep, pot-like pits with undercut edges on the rear side of the mass (the side now facing the center of the Foyer); cylindrical holes like the bore holes of Canyon Diablo; small shallow depressions which are found over most of the surface.

The broad shallow hollows on the front side (brustseite) of the meteorite form basins and furrows or channels which are most numerous in the half of the cone farthest away from the apex. Some of these show an approximately radial orientation with the deeper ends away from the apex of the cone, and several look as if they might have been made with a tool like a gigantic "countersink." The broad portion of these pits is generally uphill from the usually pointed bottom. The most prominent of the basins is a double heart-shaped cavity, 18 inches long,

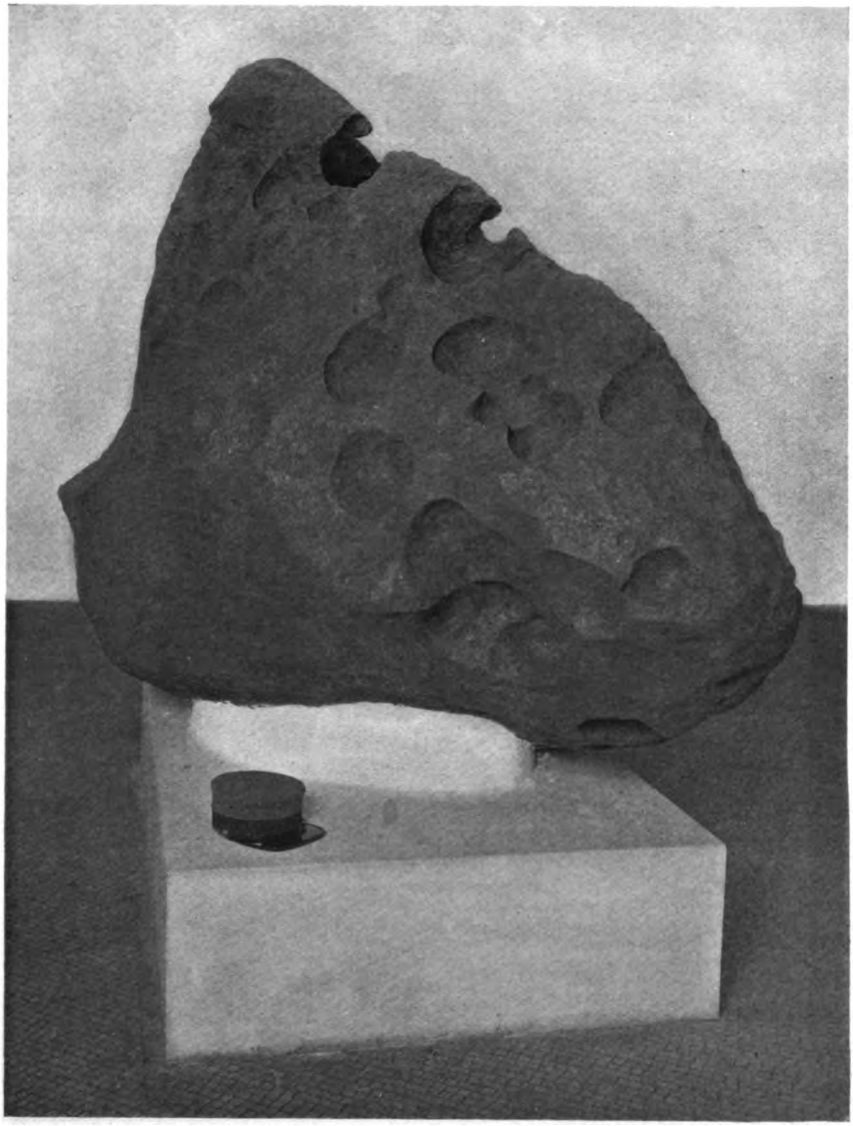
[1] Proc. Roch. Acad. Sci., Vol. iv, pp. 137–148, pl. 13–18. March 24, 1904.
[2] Science, N. S., Vol. xix, p. 108. January 15, 1904.

17 inches wide, and 10.5 inches deep, situated toward the east end of the meteorite in its present position. The form and arrangement of these basins indicate for them, according to Ward, an origin due to friction against the atmosphere and consequent melting and flowage of the surface of the iron. Willamette contains many nodules and cylindrical masses of troïlite (a sulphide of iron peculiar to meteorites), which is more easily fusible than the surrounding nickel-iron. These areas therefore may have formed the starting points for vortex action and consequent excavation by the condensed atmosphere during the flight of the meteorite through the air to the earth; but the original shape of the hollows must have been altered by subsequent oxidation.

It seems too much, however, to assert that all the depressions on the front of the meteorite are due to friction against the atmosphere. Those with basin-like lip and definite radial orientation may well be due primarily to this cause, though enlarged by subsequent terrestrial oxidation; but others with undercut edges and without radial orientation with reference to the apex of the cone are more probably the result of terrestrial oxidation, like the great cavities of the rear of the mass.

The channels which are observed near the edge of the meteorite are oriented like the basins just described and probably had the same origin. One of the channels is 21 inches long, 10 inches wide, and 7.5 inches deep. Perhaps they began around initial elongated masses of troïlite. Some of the channels, or furrows, connect with the great hollows of the rear side of the meteorite, piercing the mass.

The deep, pot-like pits of the rear portion of Willamette are the most striking superficial characteristic of the meteorite. Some are nearly circular in outline, while others are very elongate ellipses. The largest two are irregular ellipses about 42 inches long, 18 inches wide, and 17 and 18 inches deep. These great pits are compound, their bottoms showing that several small cavities have coalesced to form the large ones. All the cavities on this side of the meteorite increase in diameter below the orifice, *i. e.*, they are undercut. Some of the large cavities have smaller holes of the same character in their bottoms which were



THE WILLAMETTE METEORITE
Eastern half of front, or "Brustseite," showing fusion and erosion hollows and channels

discovered only when the thick rust and scale within them had been removed. The bottoms of the great cavities extend to essentially the same plane, about 18 inches below the general external surface.

Between the cavities there are hourglass-shaped pillars with nearly flat tops in which are many small flask-shaped holes three or more inches deep with orifices half an inch to one and one-half inches across. These are arranged in definite lines extending obliquely across the base of the meteorite in two directions nearly at right angles to each other. The great cavities are arranged in corresponding manner with their longer diameters parallel to one or the other system of lines of small holes. The character and arrangement of the cavities on the rear side of the meteorite indicate clearly that we have here a result of decomposition and erosion. Exactly analogous pits and cavities have been observed in beds of limestone and gypsum, where there can be no doubt of their erosional origin.

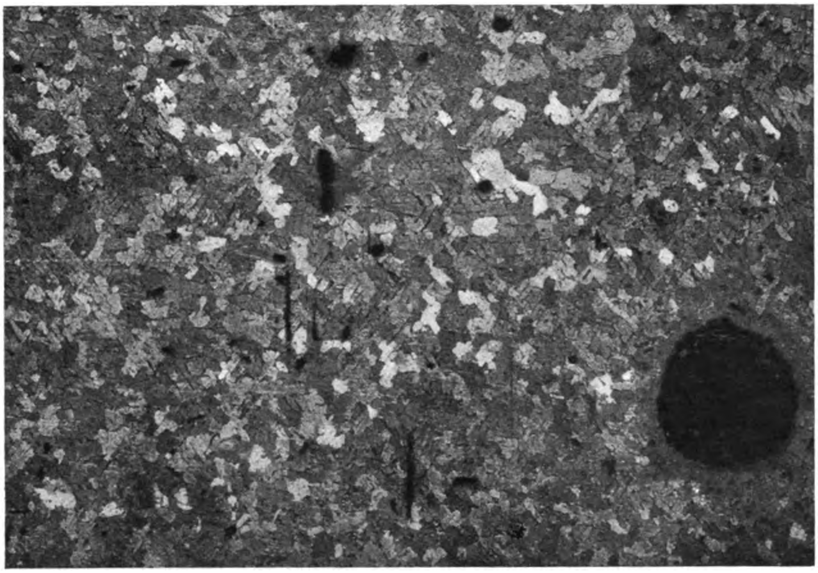
The climate of the region where the meteorite was found is extremely moist, without excessive rainfall, and there is comparatively little snow and ice, hence the conditions are exceptionally favorable to rapid oxidation and disintegration. The land is forest-covered, so that humus acids and carbonic acid are supplied in abundance to assist the destructive work of the water. The process seems to have been a simple one, the nodules and rods of troïlite which are scattered through the mass having formed centers of ready attack for the oxidizing agents. These areas of troïlite have been near enough together in certain directions to lead to the speedy coalescence of the cavities produced and the consequent formation of the great elongate basins. Troïlite nodules may be seen now in several of the cavities.

The cylindrical holes are somewhat irregular in their shape below the orifice. They are from 1½ to 3 inches in diameter and of varying depth up to 6 or 8 inches. They show most clearly in the illustration on page 107 along the upper rim of the meteorite. These holes resemble the bore-holes of Canyon Diablo, Chupaderos and other iron meteorites, and are thought to have been begun by fusion or erosion of rod-like masses of troïlite.

The small, shallow depressions which Professor Ward has

identified as "piezographs" are most conspicuous in a border zone eighteen or twenty inches wide which extends entirely around the rear of the mass. They are from one to three inches in diameter, with a depth approximately one-eighth as great. True piezographs, however, are surface features and are assigned to the heating and attrition due to the action of the greatly condensed air upon a meteorite and particularly upon the front, or brustseite, during its flight through the earth's atmosphere. Three considerations show that the small shallow depressions referred to upon Willamette are not piezographs: they are more abundant upon the rear than upon the front of the mass; they cover the inner surface of the great decomposition cavities in the rear, where they could not possibly have been caused by the friction of the atmosphere, as well as the exterior of the mass; the present exterior surface of the meteorite cannot be considered the original surface at the time of fall, and it may be far removed therefrom. Many pounds of rust and scale were left in the ground when Willamette was lifted out of its first earthly resting place, and it is not probable that the present surface bears any trace of the minor characteristics of the original surface. These slight depressions therefore are to be regarded as one of the features of the great iron which are due to unequal oxidation.

The internal character of the mass has been studied on an etched section in the Ward-Coonley Meteorite Collection on deposit in the Museum and on broken surfaces of the meteorite itself. The fracture shows the iron to be remarkable for its coarsely granular texture, the grains being bounded by almost definite planes suggesting crystals. The etched surface shows that Willamette is to be placed among the Broad Octahedrites (Og), No. 56 of Brezina's system of classification. In this class the lamellæ composing the iron are from 1.5 to 2 mm thick. The lamellar structure is somewhat obscured by plates, or flakes, of brighter and more lustrous iron. Most of these areas seem to have no definite outline, but the presence of Neumann lines on the larger ones indicates a crystalline character for them different from that of the main mass as indicated by the lamellæ (Ward). The pronounced lamellæ are the purer iron and are called kamacite, the definite lines bounding the kamacite plates are rich in



THE WILLAMETTE METEORITE

Polished and etched section showing Widmanstätten lines. The black spots are nodules and rods of Troïlite. Natural size. Ward-Coonley Collection.

THE WILLAMETTE METEORITE

H. A. Ward, Photo.

In the forest near Oregon City, Oregon

AN EXPEDITION TO CULEBRA AND PORTO RICO.

DURING the winter Professor N. L. Britton, director of the New York Botanical Garden, organized an expedition to Culebra and Porto Rico and very kindly invited Professor W. M. Wheeler to accompany him for the purpose of studying the terrestrial invertebrate fauna of the islands. The party reached San Juan, Porto Rico, March 1, when Professor Britton, Doctor Marshall A. Howe and Professor Wheeler left the remainder of the party and were conveyed on the U. S. naval tug "Peoria" to Culebra, a dry, hilly island with an area of about 12 square miles, half way between the eastern end of Porto Rico and the Danish island St. Thomas. Capt. B. F. Walling, commandant of the naval station at Culebra, courteously provided quarters for the party on board the U. S. supply ship "Alliance," at anchor in the beautiful land-locked harbor, and furnished a temporary laboratory on the adjacent shore. Capt. Walling and Capt. T. F. Lynn, commanding the marines at Culebra, did everything in their power to assist the party in their exploration of the island. Launches and small boats were provided for work along the shore and horses for reaching the remoter parts of the island. Ten days were spent in a careful biological survey of the region, Professor Britton working on the land plants, Doctor Howe on the marine algæ and Professor Wheeler on the terrestrial invertebrates. A practically complete series of the myriapods, spiders, ants and other insects was secured for the American Museum.

On completing the work at Culebra the party returned to San Juan and on March 13 joined the other members of the party, Mrs. Britton, Miss Delia Marble and Mr. John F. Cowell, director of the Buffalo Botanical Garden, at Arecibo on the northern coast of the island. Carriages were obtained at Arecibo and the whole party traveled across the mountains on the fine new turnpike through scenery of exquisite beauty, in the direction of Ponce. The little mountain town of Utuado on this route was selected as an appropriate base for a week's collecting. Many specimens were taken in the cafetals and platanals of the ravines along the Rio Grande, a charming mountain stream

Family ALCIDÆ. Auks, Murres and Puffins.

Puffin (*Fratercula arctica*). There is but one recent record of its occurrence, December 15, 1882, Center Moriches, L. I. (Dutcher, Auk, V, 1888, p. 171).

Black Guillemot (*Cepphus grylle*). Breeds from the Bay of Fundy northward; in winter migrates southward, regularly to Massachusetts. It has been found but once in Connecticut (Stony Creek, Dec. 1887.—Sage, Auk, VII, 1890, p. 283), and the only Long Island record, given by Lawrence, is apparently based on a specimen in the Lawrence Collection labeled "Long Island" (Coll. Am. Mus. No. 64,614).

Brünnich's Murre (*Uria lomvia*). Breeds from the Magdalen Islands northward; in winter migrates southward as far as New Jersey. On the western end of Long Island it is as a rule uncommon; at the eastern end it occurs more frequently, but is irregular (Dutcher, Auk, II, 1885, p. 38). During some seasons, however, the bird becomes common in our waters (Averill, Auk, VIII, 1891, p. 307). Giraud's record of "*Uria troile*" doubtless refers to this species. Specimens in the Lawrence Collection originally labeled "*U. troile*" are *U. lomvia*. Records of the occurrence of this species on Long Island during the winter are given by Braislin (Auk, XX, 1903, p. 51).

Razor-billed Auk (*Alca torda*). Breeds from the Magdalen Islands northward; in winter migrates southward, regularly to Long Island and rarely to Virginia and North Carolina.

Dovekie (*Alle alle*). A species of the far north, migrating southward in winter, more or less regularly to New Jersey. With us its numbers vary during different winters. It is considered by Dutcher to be generally a rare bird on Long Island (Abst. Linn. Soc. No. 4, 1892, p. 6), but is given by Scott as a regular winter visitant on the New Jersey coast (Bull. Nutt. Orn. Club, IV, 1879, p. 228).

Order LONGIPENNES. Long-winged Swimmers.

Family STERCORARIIDÆ. Skuas and Jægers.

Pomarine Jæger (*Stercorarius pomarinus*). Passes the nesting season chiefly within the Arctic Circle and migrates southward from July to late October, during which period it is sometimes not uncommon off our coast, its presence depending largely on the abundance of the small fish on which it feeds (Baird, Auk, IV, 1887, p. 71).

Parasitic Jæger (*Stercorarius parasiticus*). Occurs off the coast in this vicinity as a regular migrant with the preceding species.

Long-tailed Jæger (*Stercorarius longicaudus*). During its migration it is sometimes not uncommon off our coast.

Family LARIDÆ. Gulls and Terns.

Ivory Gull (*Pagophila alba*). A boreal species of which there appears to be but one record, that of an adult taken at Sayville, L. I., January 5, 1893 (Dutcher, Auk, XII, 1895, p. 290).

Kittiwake Gull (*Rissa tridactyla*). A common late fall transient visitant and a comparatively rare winter resident, occuring generally some distance off-shore (Dutcher, MS).

Glaucous Gull; Burgomaster (*Larus glaucus*). Several specimens have been killed on the Lower Hudson River, and off Long Island it is found regularly in small numbers (Dutcher, MS).

Iceland Gull (*Larus leucopterus*). A northern species of which but one valid record exists for this vicinity, Rye, N. Y. March 3, 1894 (Porter, Auk, XII, 1895, p. 76; see also Dwight, Auk, XXIII, 1906, p. 37, where a second specimen reported by Porter, and incorrectly recorded by Chapman as *leucopterus*, is given as *L. kumlieni*).

Kumlien Gull (*Larus kumlieni*). There are two records of this rare Gull for this vicinity, one is based on an immature male shot March 8, 1898, at Rockaway Beach, L. I. (Braislin, Auk, XVI, 1899, p. 190 and XXII, 1905, p. 168, where the specimen is definitely identified), the other an immature female taken February 16, 1894, at Stamford, Conn. (Porter, Auk, 1895, p. 76; see also Dwight, Auk, XXIII, 1906, p. 37, where this specimen incorrectly identified by Chapman is re-determined).

Great Black-backed Gull (*Larus marinus*). A regular winter resident not uncommon along the coast, but rarely ascending our rivers.

***Herring Gull** (*Larus argentatus*). This is the common winter Gull of our harbor and coast. It arrives from the north in September and is abundant until April. The adults are pearl gray; the immature birds, or young born the previous summer, are grayish brown. There has been an evident increase in the numbers of this species since certain of its breeding grounds have been protected. Braislin states that non-breeding birds are now common on the south shore of Long Island during the summer (Auk, XXII, 1905, p. 168).

Ring-billed Gull (*Larus delawarensis*). A rather uncommon spring and fall migrant and winter resident (Dutcher, MS). Braislin (Auk, XXII, 1905, p. 168) states that this species is not uncommon on Long Island in the summer, that it occurs in large numbers in October, but that he has no record later than November 17.

Laughing Gull (*Larus atricilla*). Formerly a common summer resident on Long Island, but now known to nest only on Great South Bay, where it is rare. (See group, second floor).

Bonaparte's Gull (*Larus philadelphia*). A regular spring and fall migrant, sometimes seen in winter.

Little Gull (*Larus minutus*). This is a European species; the only satisfactory records of its occurrence in North America are those of immature birds taken on Fire Island, Long Island, September 15, 1887 (Dutcher, Auk, V, 1888, p. 172), and Rockaway Beach, L. I., May 10, 1902 (Braislin, Auk, XX, 1903, p. 52).

Sabine's Gull (*Xema sabinii*). A circumpolar species breeding in the Far North and rarely coming as far south as northern United States. Giraud records a specimen shot at Raynor South, Long Island, "July, 1837."

Gull-billed Tern (*Gelochelidon nilotica*). A southern species breeding as far north as Virginia, and wandering occasionally to Maine. There are several Long Island records, the most recent being two specimens taken at South Oyster Bay, July 4, 1882 (Dutcher, Auk, I, 1884, p. 34), and one shot from a flock of five on Shinnecock Bay, July 8, 1884 (Dutcher, Auk, II, 1885, p. 38).

Caspian Tern (*Sterna caspia*). A rather uncommon fall migrant. There appears to be but one spring record, that of two adult males taken at Amityville, L. I., May 12, 1898 (Braislin, Auk, XVI, 1899, p. 191).

Royal Tern (*Sterna maxima*). There is but one instance of its occurrence on Long Island, a specimen taken at Raynor South, August 27, 1831, by J. F. Ward (Am. Mus. No. 46,008, Lawrence Coll.).

Forster's Tern (*Sterna Forsteri*). More common in the interior than on the Atlantic coast, where it is not known to breed north of Virginia. It wanders irregularly northward and is sometimes found in this vicinity.

Common Tern; **Sea Swallow** (*Sterna hirundo*). Inhabits the greater part of the Northern Hemisphere; in North America breeds locally from the Arctic regions to the Gulf of Mexico. This was formerly an abundant bird along our coasts, but the relentless persecutions of millinery collectors have so reduced its numbers that it is now found in only a few isolated localities. Not many years ago it bred more or less commonly all along the Long Island coast, but until recently almost the only surviving large colony inhabited Big Gull Island. Even in this remote locality it was constantly persecuted by nest-robbing fishermen and egg collectors. Through the efforts of a number of bird-lovers, who raised a sum of money for the purpose, permission was obtained from the Lighthouse Board to have the lightkeeper on Little Gull Island appointed a special game-keeper to protect the Terns on Big Gull Island. The birds rapidly increased under this guardianship, but the subsequent use, by the United States Government, of Gull Island for the erection of fortifications has caused the Terns to abandon it. Colonies are now found at both the northern and southern ends of Gardiner's Island.

Roseate Tern (*Sterna dougalli*). "Temperate and tropical regions." In north America formerly breeding along the Atlantic coast northward irregularly to Maine; now rare north of southern New Jersey. A few pairs lived on Big Gull Island with the colony of Common Terns above mentioned, but I have not observed the species in either of the Gardiner's Island colonies.

The Arctic Tern (*Sterna paradisæa*) is included by Lawrence without remark. I know of no record of its occurrence near New York City, and Mr. Dutcher has but one specimen from Long Island, a male taken on Ram Island Shoals, July 1, 1884.

Least Tern (*Sterna antillarum*). Formerly a common summer resident in suitable places on the coasts in this vicinity, but now occurs only as a rare migrant.

Sooty Tern (*Sterna fuliginosa*). A southern species, not breeding north of North Carolina, but occasionally straying farther up the coast. It has been recorded from Lake Ronkonkoma, L. I. (Dutcher, Auk, III, 1886, p. 433), and Highland Falls, N. Y. (Mearns, Bull. Essex. Inst. XII, 1879, 87).

Black Tern (*Hydrochelidon nigra surinamensis*). A species of the interior, breeding from Kansas and Illinois to Alaska. Occurs on the Atlantic coast as an irregular migrant, usually in the fall, sometimes in considerable numbers.

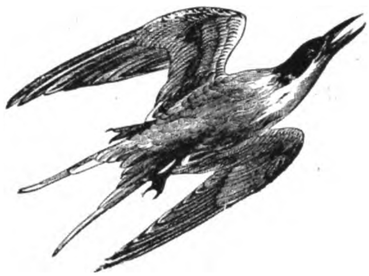


FIG. 2. TERN.

FAMILY RYNCHOPIDÆ. SKIMMERS.

Black Skimmer (*Rynchops nigra*). A southern species, not breeding north of Maryland, but occasionally wandering up the coast after the breeding season. There are several records of its occurrence on Long Island during the summer.

ORDER TUBINARES. TUBE-NOSED SWIMMERS.

FAMILY PROCELLARIIDÆ. FULMARS AND SHEARWATERS.

Fulmar (*Fulmarus glacialis*). An arctic species which sometimes wanders southward to Massachusetts. One was found in an exhausted condition at Ridgewood, New Jersey, December, 1892, after a storm (Hales, Orn. and Oöl., XVII, 1892, p. 39).

Cory's Shearwater (*Puffinus borealis*). A pelagic species, sometimes not uncommon off our coasts from August to November. It has been recorded from Amagansett (Dutcher, Auk, V, 1888, p. 5). to Cape Cod, Massachusetts, but doubtless occurs along our coast to the southward. Braislin records two specimens shot off Fire Island Inlet, October 4, 1902 (Auk, XXI, 1904, p. 287).

Greater Shearwater (*Puffinus gravis*). A pelagic species, found on the Atlantic Ocean from Cape Horn to Greenland. Its breeding place is unknown. It appears off our coasts in early June and is irregularly common until November.

Audubon's Shearwater (*Puffinus lherminieri*). A southern species, breeding in the Bahamas and Bermudas, and rarely wandering northward to Long Island (Dutcher, Auk, V, 1888, p. 173).

Sooty Shearwater (*Puffinus griseus*). Known from the North Atlantic southward to South Carolina. It is found off our coasts associated with the Greater Shearwater, but is much less common.

The Stormy Petrel (*Procellaria pelagica*) is included by Lawrence in his "Catalogue of Birds Observed on New York Island" etc., but the record is not accompanied by data, nor is there a specimen of the bird from this vicinity in the Lawrence Collection.

Leach's Petrel (*Oceanodroma leucorhoa*). Breeds from Maine northward, and in the winter ranges southward to Virginia. It is rather uncommon in this vicinity.

Wilson's Petrel (*Oceanites oceanicus*). Nests in the islands of the Southern Seas (Kerguelen Island) in January and February and migrates northward after the breeding season, reaching the waters of our coasts in May and remaining until late September. It sometimes enters the Lower Bay of New York harbor in numbers.

FIG. 3. PETREL.

ORDER STEGANOPODES. TOTIPALMATE SWIMMERS.

FAMILY SULIDÆ. GANNETS.

Booby (*Sula leucogaster*). Coasts and islands of tropical and sub-tropical America, north of Georgia. Accidental on Moriches Bay, L. I. (Dutcher, Auk, X, 1893, p. 270).

Gannet (*Sula bassana*). A spring and fall migrant, usually occurring well off shore.

FAMILY PHALACROCORACIDÆ. CORMORANTS.

Cormorant (*Phalacrorcorax carbo*). It is not common south of Maine, and is rare in this vicinity.

Double-crested Cormorant (*Phalacrocorax auritus*). A common spring and fall migrant.

FAMILY PELECANIDÆ. PELICANS

White Pelican (*Pelecanus erythrorhynchos*). Now rare or accidental on the Atlantic coast. Two specimens have been taken in this vicinity, one at Canarsie Bay, L. I. (Dutcher, Auk, X, 1893, p. 270), the other, a male, at Roslyn, May 11, 1885 (Forest and Stream, XXIV, 1885, p. 328).

Brown Pelican (*Pelecanus occidentalis*). Breeds as far north as South Carolina and occasionally strays up the coast as far as Massachusetts. DeKay records a specimen from Sandy Hook.

ORDER ANSERES. LAMELLIROSTRAL SWIMMERS.

FAMILY ANATIDÆ. DUCKS, GEESE AND SWANS.

American Merganser; Shelldrake (*Merganser americanus*). Not common from November to April.

Red-breasted Merganser; Shelldrake (*Merganser serrator*). On Long Island it is a very common spring and fall migrant (Dutcher, MS).

Hooded Merganser (*Lophodytes cucullatus*). A not common migrant and occasional winter visitant.

Mallard (*Anas boschas*). An irregular transient visitant, occurring in spring, winter and fall.

***Black Duck** (*Anas obscura*). Breeds from New Jersey to Labrador and winters from Massachusetts southward. It formerly nested in this vicinity, but now is found chiefly as a migrant, and less commonly in the winter. It still nests at some points on the Jersey coast and in a few localities on Long Island, (Dutcher, MS). (See group, second floor).

The Red-legged Black Duck, a supposed race of the Black Duck has been recorded from Long Island by Braislin (Auk, XXI, 288), but the status of this form is as yet too unsettled to make it desirable definitely to introduce it here.

Gadwall (*Chaulelasmus streperus*). A very rare migrant in this vicinity.

European Widgeon (*Mareca penelope*). An Old World species which occurs rarely on our coast. It has been taken at Leonia, N. J. (Chapman, Auk, VI, 1889, p. 302).

Baldpate; American Widgeon (*Mareca americana*). An irregular transient visitant.

European Green-winged Teal (*Nettion crecca*). An Old World species of rare occurrence on our coasts. It is recorded from Trenton, N. J. (Abbott, Geology of New Jersey, 1868, p. 792), Hartford, Conn. (Treat, Auk, VIII, 1891, p. 112), and from Merrick, L. I., where two specimens were captured in December, 1900 (Braislin, Auk, XIX, 1902, p. 145).

Green-winged Teal (*Nettion carolinensis*). A rather uncommon spring and fall migrant and winter resident.

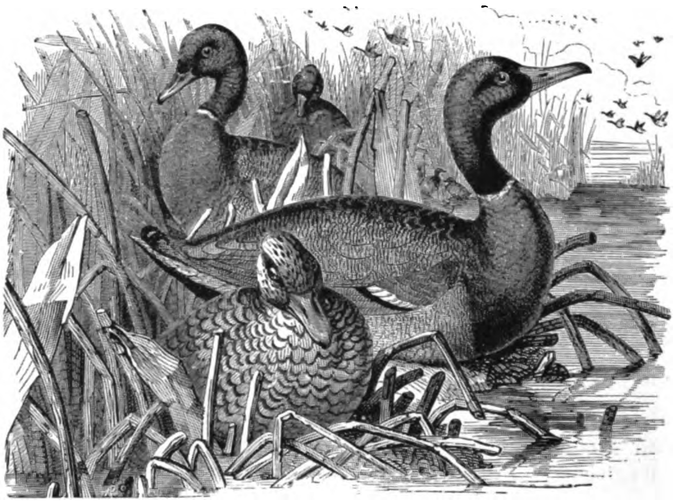


FIG. 4. MALLARDS.

Blue-winged Teal (*Querquedula discors*). A not common spring and common fall migrant.

Shoveller; Spoonbill (*Spatula clypeata*). A rare and irregular transient visitant.

Pintail; Sprigtail (*Dafila acuta*). A common migrant.

***Wood Duck; Summer Duck** (*Aix sponsa*). The Wood Duck is a rare summer resident on some of our more retired, wooded streams and becomes more common during the migrations.

The Rufous-crested Duck (*Netta rufina*) is an Old World species which is known as North American only from one specimen found in Fulton Market, New York City, and supposed to have been shot on Long Island.

Redhead (*Aythya americana*). On Long Island this species occurs as a regular migrant, in varying numbers, and is occasionally found in the winter (Dutcher, MS).

Canvasback (*Aythya vallisneria*). Occurs here as a not common migrant.

American Scaup Duck; Broad-bill; Blue-bill; Black-head; Raft Duck (*Aythya marila*). The commonest Duck of our bays, where it is sometimes seen in great numbers. It appears from the north about October 1 and remains until its feeding grounds are frozen over, returning as soon as the ice breaks in the early spring.

Lesser Scaup Duck; Little Blue-bill; Creek Broadbill; Raft Duck (*Aythya affinis*). Not as common as the preceding, with which its range in the main agrees.

Ring-necked Duck (*Aythya collaris*). North America, breeding only in the interior from Iowa northward. It is here a very rare, irregular transient visitant. The last record is that of Braislin (Auk, XVI, 1899, p. 191) who mentions a specimen from Great South Bay.

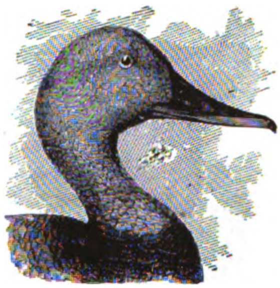


FIG. 5. CANVAS-BACK.

FIG. 6. REDHEAD.

American Golden-eye; Whistler (*Clangula clangula americana*). In favorable localities within our limits the Whistler is a not common migrant and winter resident.

Bufflehead; Butterball (*Charitonetta albeola*). A not uncommon migrant and winter resident.

Old-squaw; Old-wife; South-southerly (*Harelda hyemalis*). A common winter resident.

Harlequin Duck (*Histrionicus histrionicus*). Breeds from Newfoundland northward, and winters southward to New Jersey. A very rare winter visitant off our coast (Dutcher, Auk, III, 1886, p. 434; VI, 1889, p. 134).

The Labrador Duck (*Camptolaimus labradorius*), which formerly inhabited the Atlantic Coast, breeding from Labrador northward and wintering southward to New Jersey, is doubtless now extinct. The Labrador Duck was apparently once a not uncommon winter bird on Long Island. In a paper by William Dutcher (Auk, VIII, 1891, p. 201; see also Auk, XI, 1894, pp. 41, 175, 176.) summarizing our knowledge of its life-history and enumerating the extant specimens, Mr. George N. Lawrence is quoted as saying: "I recollect that about

forty or more years ago it was not unusual to see them in Fulton Market, and without doubt they were killed on Long Island: at one time I remember six fine males, which hung in the market until spoiled for want of a purchaser." Only forty-two of these Ducks have been recorded as existing in collections. Of this number seven are in the American Museum. (See group, second floor).

American Eider (*Somateria dresseri*). A rare winter visitant.

King Eider (*Somateria spectabilis*). Breeds from Labrador to the Arctic Regions, migrating southward regularly as far as eastern Long Island (Dutcher, Auk, V, 1888, p. 175).

American Scoter; Black Coot (*Oidemia americana*). A more or less common migrant and winter resident.

White-winged Scoter; White-winged Coot (*Oidemia deglandi*). A common migrant and winter visitant off our coasts.

Surf Scoter (*Oidemia perspicillata*). Found here with the preceding species.

Ruddy Duck (*Erismatura jamaicensis*). A not uncommon migrant, occurring in varying numbers.

Greater Snow Goose (*Chen hyperborea nivalis*). An irregular transient visitant.

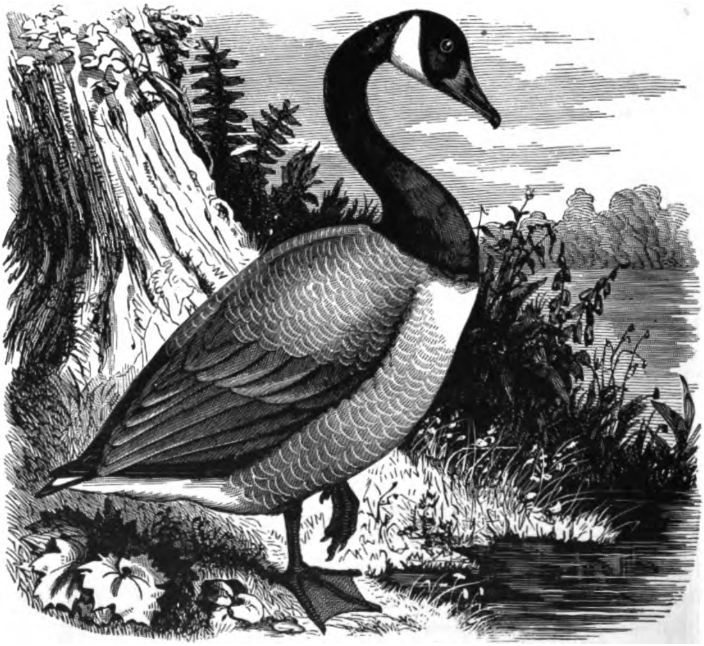


FIG. 7. CANADA GOOSE.

American White-fronted Goose (*Anser. albifrons. gambeli*). North America, breeding far northward; in winter, south to Mexico and Cuba. Rare on the Atlantic Coast. It has been recorded on Long Island from Babylon (Giraud), Great South Bay Islip and Montauk (Dutcher, Auk, X, 1893, p. 271).

***Canada Goose** (*Branta canadensis*). A common migrant, appearing in November and remaining until our bays are frozen. In the spring the last birds pass on their northward journey as late as early May.

Hutchins's Goose (*Branta Canadensis hutchinsi*). A rare migrant in this vicinity.

White-bellied Brant (*Branta bernicla glaucogaster*). A common bird, appearing from the north in October and remaining until our bays are frozen, when it retreats farther southward. In April it returns, and the migration is not concluded until May.

Black Brant (*Branta nigricans*). This is a western species which is occasionally found on our coasts. It has been recorded from Egg Harbor, N. J. (Lawrence), Babylon and Islip, L. I. (Dutcher, Auk, 1893, pp. 266, 271).

Barnacle Goose (*Branta leucopsis*). An Old World species, occurring accidentally on our coasts. A specimen was killed on Jamaica Bay, L. I., in October, 1876 (Lawrence, Bull. Nutt. Orn. Club, II, 1877, p. 18).

Whistling Swan (*Olor Columbianus*). Breeds in the far north, and winters as far south as the Gulf of Mexico. It is an exceedingly rare bird on the Atlantic coast north of the Chesapeake. A recent record is that of a bird killed at Flatlands, L. I., within the limits of Greater New York, on Dec. 24, 1901. (Braislin, Auk, XX, 1903, p. 52).

ORDER HERODINES. HERONS, STORKS, IBISES, ETC.

FAMILY IBIDIDÆ. IBISES.

White Ibis (*Gura alba*). A bird of the Southern States, which has been recorded twice from this vicinity (Raynor South and Moriches, L. I., Giraud).

Glossy Ibis (*Plegadis autumnalis*). An Old World species of "irregular distribution in America." It has been recorded once from Southampton L. I., and once from Canarsie Bay, L. I. (Dutcher, Auk, X, 1893, p. 271).

FAMILY ARDEIDÆ. HERONS, EGRETS, BITTERNS, ETC.

***American Bittern** (*Botaurus lentiginosus*). "Temperate North America, south to Guatemala and the West Indies"; breeds but rarely south of Virginia. In this vicinity it is not common during the summer.

Least Bittern (*Ardetta exilis*). A locally common summer resident.

Great Blue Heron (*Ardea herodias*). With us it is a common migrant, and is probably found as a summer resident in a few localities. It is generally known by the name of "Crane."

American Egret (*Herodias egretta*). A southern species, breeding as far north as Virginia, and after the breeding season wandering northward in small numbers. It is here a rare and irregular summer visitant, occurring between August 1 and the last of September (Dutcher, Auk, X, 1884, p. 32). Comparatively recent records of the occurrence of this species are those of Braislin (Auk, XVII, 1900, p. 69; XIX, 1902, p. 145) and Owen (Auk, XV, 1898, p. 51).

Snowy Heron (*Egretta candidissima*). One of three individuals seen near Sayville, L. I., May 30, 1885, by William Dutcher and L. S. Foster was "carrying a long stick in its bill" (Dutcher, Auk, III, 1886, p. 435), and possibly was preparing to breed. Now an exceedingly rare bird breeding in a few isolated localities in Florida. Birds identified in life as this species are more apt to be the young of the Little Blue Heron (Braislin, Auk, XIX, 1902, p. 145).

Little Blue Heron (*Florida cærulea*). This southern species, like the preceding, wanders northward in small numbers after the breeding season, and a few are sometimes found near New York. (See group, second floor).

***Green Heron** (*Butorides virescens*). One of our commonest Herons and known under a great variety of names. It haunts the banks of streams and ponds and places its nest of sticks in a bush or the lower branch of a tree.

***Black-crowned Night Heron; Quawk** (*Nycticorax nycticorax nævius*). A locally common summer resident. There is a colony containing about 500 pairs not far from New York City. The popular name "Quawk," is derived from the call of the bird.

Yellow-crowned Night Heron (*Nyctanassa violacea*). Breeds from South Carolina southward and occasionally strays up the coast as far as Massachusetts. There is but one definite record for this region, that of a specimen taken in April, near Freeport, Queens County, L. I. (Dutcher, Auk, X, 1893, p. 286).

Order PALUDICOLÆ. Cranes, Rails, etc.

Family RALLIDÆ. Rails, Gallinules and Coots.

King Rail (*Rallus elegans*). Breeds as far north as Connecticut and has been known to stray to Maine. It is a rare summer resident of our fresh-water marshes (Dutcher, Auk, V, 1888, p. 176).

Clapper Rail; Meadow Hen; Marsh Hen (*Rallus crepitans*). This is an exceedingly common summer resident of the salt marshes of our coasts. Occasionally it winters in our region. (See group, second floor).

Virginia Rail (*Rallus virginianus*). A locally common summer resident, a few remaining during the winter.

Sora; Carolina Rail; Rail-bird (*Porzana carolina*). A rare summer resident in this vicinity, but in the fall it becomes common, feeding on wild rice of our marshes where, however, it is yearly becoming less numerous.

Yellow Rail (*Colurnicops noveboracensis*). Little is known about the nesting habits of this bird. It haunts grassy marshes and seeks safety by hiding or running, and for this reason is rarely seen. Several have been taken during the fall migration in this vicinity, and it is doubtless more common than is generally supposed. (See group, third floor.)

Black Rail (*Creciscus jamaicensis*). This bird, though much rarer, has as far as known the same habits as the preceding species and like it is very difficult to observe. It has been taken in the spring at Jamaica Bay and doubtless breeds in this vicinity, since its nest has been found at Saybrook, Conn. (Clarke, Auk, I, 1884, p. 394). (See group, third floor).

Corn Crake (*Crex crex*). This is an Old World species which sometimes strays to Greenland and our Atlantic coast. In this region there are records for Sag Harbor, L. I. (Dutcher, Auk, III, 1886, p. 435), Oakdale, L. I. (Dutcher, Auk, V, 1888, p. 177), and Saybrook, Conn. (Clark, Orn. and Oöl., XIII, 1888, p. 45).

Purple Gallinule (*Ionornis martinica*). Tropical America, breeding as far north as South Carolina, and straying casually to Maine. There are but two definite records for this region, Middle Island, L. I. (Helme, Orn. and Oöl., VII, 1882, p. 118) and Indian Pond, near Flatlands, L. I. (Dutcher, Auk, X, 1893, p. 272).

Florida Gallinule (*Gallinula galeata*). Temperate and tropical America, breedng as far north as Maine, and wintering from Florida southward. It breeds only locally in the northeastern part of its range, frequenting the borders of ponds or streams surrounded by marshy grounds. Its nest has not been found in the immediate vicinity of New York City, where it is known only as a rare migrant.

***Coot; Mud-hen; Crow-duck** (*Fulica americana*). The Mud-hen is a not uncommon bird during migration, but it is recorded as breeding only near Morristown, N. J. (Thurber, True Democratic Banner, newspaper, Nov. 10, 1887).

ORDER LIMICOLÆ. SHORE BIRDS.
FAMILY PHALAROPODIDÆ. PHALAROPES.

Red Phalarope (*Crymophilus fulicarius*). The Phalaropes are pelagic birds, not often coming to our coasts unless driven shoreward by storms. There are both August and May records for this species on Long Island.

Northern Phalarope (*Phalaropus lobatus*). This bird occurs with us as a regular migrant, and after severe storms it is sometimes common in flocks. (Dutcher, Auk, 1884, p. 33).

Wilson's Phalarope (*Steganopus tricolor*). Interior of North America, breeding from northern Illinois northward. With us it is a very rare and irregular migrant.

FAMILY RECURVIROSTRIDÆ. AVOCETS AND STILTS.

American Avocet (*Recurvirostra americana*). A bird of the interior, breeding from Texas to the Saskatchewan. Giraud mentions it as casual on Long Island, and says that a few bred at Egg Harbor, N. J. (Dutcher records four individuals seen by Col. Nicholas Pike on Long Island as follows: Ponquogue, 1844; Canarsie Bay, 1847; Southampton, two, no date (Auk, X, 1893, p. 272).

Black-necked Stilt (*Himantopus mexicanus*). A southern species, breeding in the Gulf States and locally in the Mississippi Valley and westward; rare on the North Atlantic coast. Giraud mentions it as "unfrequent," and Dutcher records two specimens taken by Colonel Pike on Great South Bay, one of them in 1843 (Auk, X, 1893, p. 272).

FAMILY SCOLOPACIDÆ. SNIPES, SANDPIPERS, ETC.

European Woodcock (*Scolopax rusticola*). The only record for the occurrence of this species in this vicinity is based on a specimen found in Washington Market, December 6, 1859, which was said to have been killed near Shrewsbury, N. J. (Lawrence, Ann. Lyc. Nat. Hist., VIII, 1866, p. 223).

***Woodcock** (*Philohela minor*). The woodcock is a not uncommon summer resident and more numerous fall migrant. Owing to the clearing of timber areas, draining of lands and demands of sportsmen, it is however, yearly decreasing in numbers in the vicinity of New York. It arrives early in March, and does not leave us until the ground is frozen. (See group, second floor).

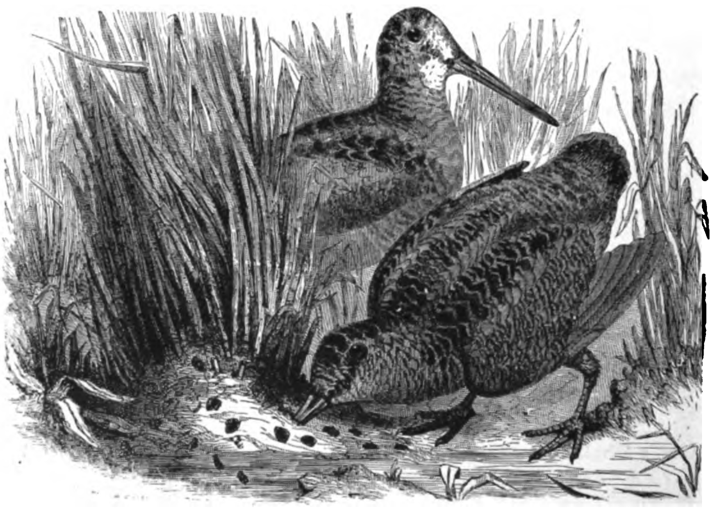


FIG. 8. WOODCOCK.

Wilson's Snipe; English Snipe (*Gallinago delicata*). A not uncommon migrant, and crippled birds are said to have nested on several occasions near Chatham, N. J. (Herrick, Forest and Stream, XII, 1879, p. 165). During mild seasons a few pass the winter here (Dutcher, MS).

Dowitcher (*Macrorhamphus griseus*). A common migrant, arriving from the south about May 1 and returning from the north between July 10 and August 15.

Migrating Snipe, Sandpipers and Plovers fly, as a rule, some distance off the land and if the weather is calm and clear, very few birds are found on our shores. If, however, during their migrations storms from the right quarter, or fogs occur, many birds are driven shoreward and there results what among sportsmen is known as a "flight."

Long-billed Dowitcher (*Macrorhamphus scolopaceus*). This western representative of our common Dowitcher is a rare but regular late fall migrant along the Atlantic coast.

Stilt Sandpiper (*Micropalama himantopus*). A not common but by no means rare migrant, occurring chiefly during the fall migration from the middle of July to the middle of September.

Knot; Robin Snipe (*Tringa canutus*). A common migrant, passing northward during May and returning from the middle of July to the first of October.

Purple Sandpiper (*Arquatella maritima*). A rare but regular winter resident.

Pectoral Sandpiper; Krieker (*Actodromas maculata*). A common and sometimes abundant fall migrant in this vicinity; less frequently seen in the spring. It returns from the north in early August, and its migration is concluded about the last of October.

White-rumped Sandpiper (*Actodromas fuscicollis*). A not uncommon spring and fall migrant.

Baird's Sandpiper (*Actodromas bairdi*). Casual on the Atlantic coast. There are several records for this vicinity, as follows: Rockaway, L. I., August, two specimens, and September, two specimens (N. T. Lawrence, Forest and Stream, X, 1878, p. 235), and Far Rockaway, L. I., August, one specimen (N. T. Lawrence, Auk, II, 1885, p. 273).

Least Sandpiper; Peep; Meadow Oxeye (*Actodromas minutilla*). This is one of our commonest Sandpipers, and shares the names "Peep" or "Oxeye" with the Semipalmated Sandpiper. It is seen in small flocks running along our shores and beaches. It passes northward during May and returns about July 10, the fall migration being concluded about September 1.

Red-backed Sandpiper; Lead-back (*Pelidna alpina sakhalina*). A very common migrant on our coasts, less common in the spring than in the fall. It migrates northward in early May and returns about September 1, remaining until November.

Curlew Sandpiper (*Erolia ferruginea*). "Old World in general, occasional in eastern North America." There are several records of its occurrence on Long Island.

Semipalmated Sandpiper; Peep; Sand Oxeye (*Ereunetes pusillus*). This is our most common Sandpiper, and during its fall migration it is abundant along our shores in small flocks. It migrates northward during May, returns about July 10, and the fall migration is not concluded until about October 1.

Western Sandpiper (*Ereunetes mauri*). This is the western representative of the preceding species. It is not infrequently found on our coast, generally associated with *E. pusillus*. Braislin (Auk, XVI, 1899, p. 191) records it as abundant on Long Island in the fall of 1897.

Sanderling; Surf Snipe (*Calidris alba*). An abundant migrant along our coasts, where, as a rule, it is found on the outer beaches. It passes northward during May and returns on its southward journey about July 10, from which date until October it is more or less numerous.

Marbled Godwit; Brown Marlin (*Limosa fedoa*). This is a rare bird on the Atlantic coast, where it occurs only as an irregular fall visitant.

Hudsonian Godwit; Ring-tailed Marlin (*Limosa hæmastica*). In this vicinity the Ring-tailed Marlin is an irregular fall migrant (Dutcher, Auk, III, 1889, p. 437). Kobbe (Auk, XXI, 1904, p. 79) records a flight of this species as occurring at Quogue, L. I., August 31, 1903.

***Greater Yellow-legs** (*Totanus melanoleucus*). A common migrant, arriving in the spring about the latter half of April and returning in the latter half of July, the migration not being concluded until November.

Yellow-legs; Summer Yellow-legs (*Totanus flavipes*). Very rare in the spring, but abundant during its southward migration, which begins about July 15 and ends in September.

***Solitary Sandpiper** (*Helodromas solitarius*). A not uncommon migrant passing northward in May and returning in July. It is not a true Shore-bird, but is more frequently found near fresh-water ponds and streams.

Willet (*Catoptrophorus semipalmatus*). In this vicinity it occurs only as a rare fall migrant. It is probable that the Western Willet (*C. s. inornata*) is also occasionally found on our coasts.

Ruff (*Pavoncella pugnax*). "Northern parts of the Old World, straying occasionally to eastern North America." There are three specimens of this bird in the American Museum from North America, two of which, in the Lawrence Collection, are labeled "Long Island," while the third is in the Elliot Collection and is labeled "Barnegat, N. J." (For record of the occurrence of this species in America, see Deane, Auk, XXII, 1905, p. 411; and Palmer, Auk, XXIII, 1906, p. 99.)

Bartramian Sandpiper; Upland Plover; Field Plover (*Bartramia longicauda*). A rather rare migrant and still rarer summer resident. It arrives about the middle of April and frequents fields and pastures.

Buff-breasted Sandpiper (*Tryngites subruficollis*). A bird of the interior, breeding in the far north and wintering in South America. It is very rare on the Atlantic coast. Giraud records "a party of five" as seen in August and September (N. T. Lawrence, Forest and Stream, X, 1879, p. 235); one was taken in August at Montauk Point (Berier, Bull, N. O. C., VI, 1880, p. 126); Dutcher mentions an August specimen from Suffolk County and a midsummer bird from Shinnecock Bay (Auk, VI, 1889, p. 136); and Braislin records a male taken August 30, 1903 at Rockaway Beach (Auk, XXII, 1905, p. 169).

***Spotted Sandpiper; Tip-up** (*Actitis macularia*). This is the common Sandpiper so frequently seen on our ponds, streams and beaches, and is one of the few members of this family which breeds here. It arrives about April 25 and remains until October.

Long-billed Curlew; Sickle-bill (*Numenius longirostris*). A rare and irregular fall visitant.

Hudsonian Curlew; Jack Curlew (*Numenius hudsonicus*). The Jack Curlew, as it is locally known, is a not uncommon migrant in this vicinity. It passes northward in May, and the southern migration occurs between the middle of July and the first of October.

Eskimo Curlew; Dough-bird; Fute (*Numenius borealis*). This species has decreased in numbers during recent years and is believed by some ornithologists to be on the verge of extinction. There is but one record of its recent occurrence, that of a male shot by R. L. Peavey at Rockaway Beach, L. I., September 14, 1902 (Braislin, Auk, XXI, 1904, p. 289).

Family CHARADRIIDÆ. Plovers.

Lapwing (*Vanellus vanellus*). An Old World species, of accidental occurrence in America. The only record for eastern North America south of Greenland is that of a specimen shot at Merrick, L. I., December, 1883, (Dutcher, Auk, III, 1886, p. 438).

Black-bellied Plover; Beetle-head (*Squatarola squatarola*). A common migrant, more numerous in the fall. It passes northward from about April 15 to June 1, and the return migration occurs between August 1 and November 1.

Golden Plover; Green-back (*Charadrius dominicus*). A rare spring and common fall migrant, occurring chiefly in September.

Kildeer (*Oxyechus vociferus*). In the neighborhood of New York City the Kildeer is a rare summer resident and not uncommon migrant. It arrives in March and remains with us until November.

Semipalmated Plover; Ring-neck (*Ægialitis semipalmata*). The Ringneck is one of our most common shore-birds. It passes northward in May and returns about July 15, the fall migration not being concluded until October 1.

Piping Plover (*Ægialitis meloda*). It is here a rare local summer resident and more common migrant, arriving in April and remaining until September.

Wilson's Plover (*Ochthodromus wilsonius*). Breeds as far north as Virginia, and strays casually to Nova Scotia. There are several records for Long Island (Dutcher, Bull. N. O. C., IV, 1879, p. 242; Auk, III, 1886, p. 438, Shinnecock Bay), and one for Bridgeport, Conn. (Averill, List of Birds found in the vicinity of Bridgeport, 1892, p. 9).

FAMILY APHRIZIDÆ. SURF BIRDS AND TURNSTONES.

Turnstone; Brant-bird; Calico-back (*Arenaria morinella*). With us it is a common migrant passing northward in May, returning about August 1 and remaining until September.

FAMILY HÆMATOPODIDÆ. OYSTER-CATCHERS.

Oyster-catcher (*Hæmatopus palliatus*). Breeds as far north as Virginia and occasionally strays to Nova Scotia. It is here of rare and irregular occurrence (Dutcher, Auk, X, 1893, p. 272).

ORDER GALLINÆ. GALLINACEOUS BIRDS.

FAMILY TETRAONIDÆ. GROUSE, PARTRIDGES, ETC.

***Bob-white; Quail** (*Colinus virginianus*). Quail are not uncommon in the vicinity of New York, but they are so eagerly hunted, that, as the country becomes more thickly settled, only the most rigid enforcement of the game-laws will preserve them from extermination. Recent severe winters have greatly decreased the numbers of this species, virtually exterminating it in some localities, and were it not for the liberation of southern birds by sportsmen, it is probable that the species would be exceedingly rare if not indeed extinct throughout most of the region surrounding New York City. (See group, second floor).

***Ruffed Grouse; Partridge** (*Bonasa umbellus*). Partridges are much less common with us than Quails. They are birds of the woods, and for this reason disappear with the forests, while Quails, on the contrary become more numerous as the country is cleared. (See group, second floor).

In the early part of the nineteenth century Pinnated Grouse or Heath Hens (*Tympanuchus cupido*) were abundant in some parts of Long Island, but they have been extinct for about sixty years (Giraud, Birds of Long Island, p. 195, and Dutcher, Auk, X, 1893, p. 272). As late as 1860 odd this species occurred in numbers on the Plains of the Jersey Pine Barrens west of Barnegat, where it was exterminated by indiscrimate shooting at all seasons (Chapman, Bird-Lore, V, 1903, p. 50).

The Wild Turkey (*Meleagris gallopavo silvestris*) is still found in small numbers in the wilder, more mountainous portions of Pennsylvania, but has

long been extinct in this vicinity. De Kay (Zoölogy of New York, II, Birds, 1844, p. 200) writes that he had not met with the species in New York State, but was informed at the time he wrote it was found in the counties of Sullivan, Rockland, Orange, Alleghany and Cattaraugus. This species is not mentioned by either Giraud or Lawrence.

ORDER COLUMBÆ. PIGEONS.

FAMILY COLUMBIDÆ. DOVES AND PIGEONS.

Passenger Pigeon; Wild Pigeon (*Ectopistes migratorius*). Fifty years ago the Wild Pigeon was an abundant bird in the vicinity of New York, but here, as elsewhere throughout its range, it has become very rare. In place of the thousands that used to visit us it is now observed irregularly and rarely. (Lawrence, Auk, VI, 1889, p. 196, and Dutcher, Auk, X, 1893, p. 274). There appears to be but one definite record since 1894 of the occurrence of the Wild Pigeon near New York, that of an immature male shot at Englewood, N. J., June 23, 1896, by C. I. Wood (Chapman, Auk, XIII, 1896, p. 341).

***Mourning Dove**(*Zenaidura macroura*). A common summer resident, under favorable circumstances passing the winter.

Ground Dove (*Columbigallina passerina terrestris*). This is a species of the South Atlantic and Gulf States. It has been once taken in this vicinity (Grinnell, Bull. N. O. C., III, 1878, p. 147), but its occurrence is purely accidental, and it is possible that the specimen captured was an escaped cage-bird.

ORDER RAPTORES. BIRDS OF PREY.

FAMILY CATHARTIDÆ. AMERICAN VULTURES.

Turkey Vulture; Turkey Buzzard (*Cathartes aura septentrionalis*). Of more or less regular occurrence in New Jersey as far north as Plainfield in the interior and Sandy Hook on the coast. It is also occasionally seen on Long Island. One record notes the occurrence of a flock of eight birds of this species in Orange County, N. Y. (Reynolds, Forest and Stream, XVIII, 1894, p. 181).

Black Vulture (*Catharista urubu*). Breeds from North Carolina southward, and occasionally strays as far north as Maine. There are records for Sandy Hook, N. J. (Robt. B. Lawrence, Bull. N. O. C., V, 1880, p. 116), and Coney Island, L. I. (Berier, Bull. N. O. C., VI, 1881, p. 126).

FAMILY FALCONIDÆ. FALCONS, HAWKS, EAGLES, ETC.

Swallow-tailed Kite (*Elanoides forficatus*). In this vicinity it has been recorded from Raynor South, L. I. (Giraud, Birds of Long Island, p. 13), "South shore of Long Island" (Berier, Bull, N. O. C., VI., 1881, p. 126), Chatham, N. J. (Herrick, Forest and Stream, XII, 1879, p. 165), and Piermont, N. Y. (Nicholas, Auk, XVII, 1900, p. 386).

***Marsh Hawk** (*Circus hudsonius*). A permanent resident, common except during the winter.

***Sharp-shinned Hawk** (*Accipiter velox*). It is here an uncommon summer and rare winter resident.

***Cooper's Hawk** (*Accipiter cooperi*). With us a not uncommon summer and rare winter resident. This bird, the Sharp-shinned Hawk and the rare Duck Hawk and Goshawk, are the only species of our Hawks which habitually live on birds. The others feed largely on insects and small field-mice, and being thus actually beneficial, should be protected by law.

Goshawk (*Astur atricapillus*). A rare winter visitant.

***Red-tailed Hawk** (*Buteo borealis*). The Red-tail is one of our commonest Hawks and is resident throughout the year.

***Red-shouldered Hawk** (*Buteo lineatus*). A permanent resident. It is probably our most common Hawk and with the Red-tail is the one to which the name "Chicken," or "Hen Hawk," is generally, but incorrectly, applied.

Swaison's Hawk (*Buteo swainsoni*). A western species of rare occurrence on the Atlantic coast. There is apparently but one record of its capture near New York City, that of a specimen shot near Cornwall, N. Y., October 14, 1892 (Dutcher, Auk, X, p. 83).

***Broad-winged Hawk** (*Buteo platypterus*). A rather uncommon summer resident.

Rough-legged Hawk (*Archibuteo lagopus sancti-johannis*). A rare winter resident.

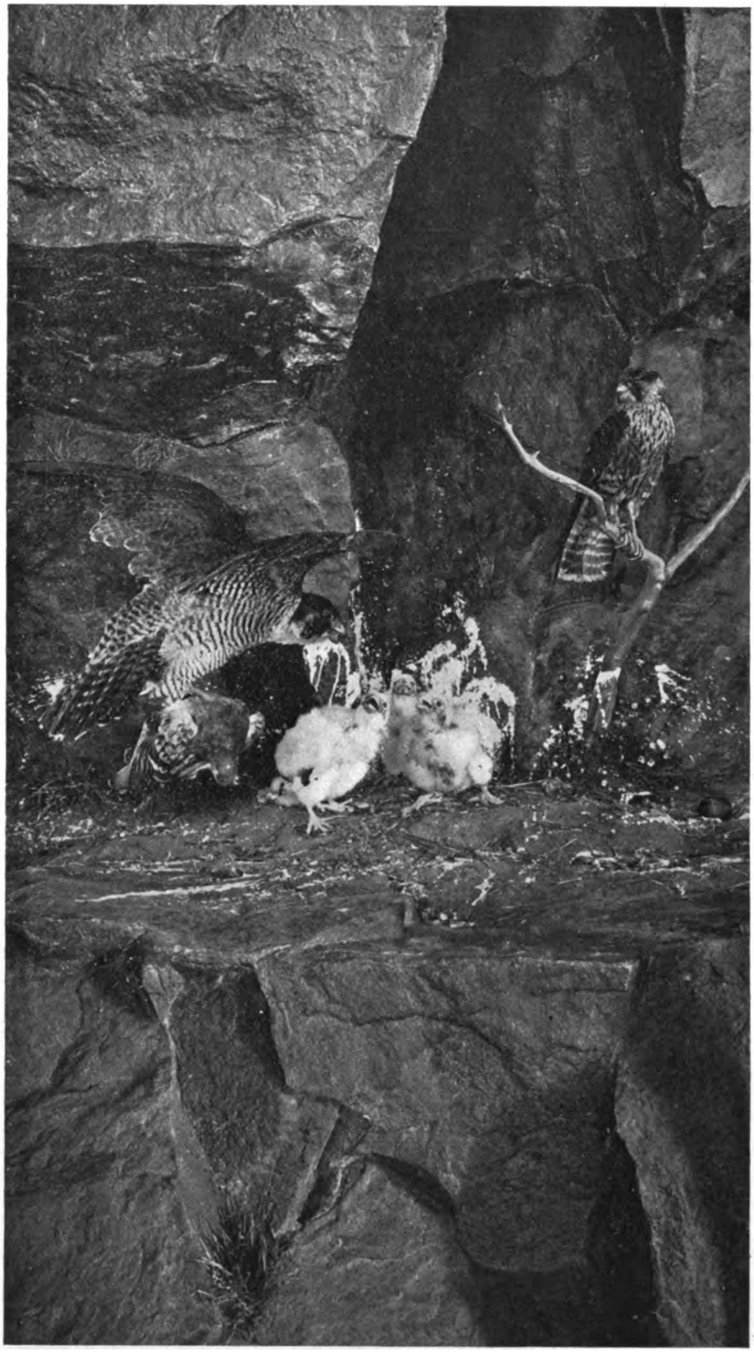
Golden Eagle (*Aquila chrysaetos*). North America, of rare occurrence east of the Mississippi. It has been recorded from Islip, L. I. (Giraud), Canarsie, L. I. (Dutcher), Gravesend, L. I. (Johnson), Long Branch, N. J. (Chapman, Auk, XV, 1898, p. 54), and Highland Falls, N. Y. where Mearns states, it is occasionally observed and was formerly known to nest.

***Bald Eagle** (*Haliætus leucocephalus*). This Eagle is here a rather rare bird; it is said by Mearns to nest in the Highlands of the Hudson. On Long Island it is a not uncommon resident and breeds in several localities (Dutcher MS).

Gyrfalcon (*Falco rusticolus gyrfalco*). An arctic species, rarely visiting the United States. The only record for this vicinity is that of a specimen killed on Long Island in the winter of 1856 (Lawrence, Ann. Lyc. Nat. Hist., New York, VIII, 1866, p. 280; see also Brewster, Auk, XII, 1895, p. 180).

Black Gyrfalcon (*Falco rusticolus obsoletus*). "Labrador, south in the winter to Maine and New York." There is but one record of its occurrence in this vicinity, viz., a specimen shot in the fall of 1875, near Flushing, L. I. (Berier, Bull. N. O. C., VI, 1881, pp. 126, 247).

Duck Hawk (*Falco peregrinus anatum*). This Falcon, the "noble Peregrine" of Falconry, is a not uncommon migrant, especially along our coast, and is a rare summer resident along the Palisades and Highlands of the Hudson, where it is known to breed. (See group, second floor).



DUCK HAWK
Group, Hall No. 204

Pigeon Hawk (*Falco columbarius*). A common migrant, occurring chiefly on our coasts.

***American Sparrow Hawk** (*Falco sparverius*). With us it is a not common resident but abundant migrant along the coasts.

American Osprey; Fish Hawk(*Pandion haliætus carolinensis*). A locally abundant summer resident arriving early in April and remaining until October. At certain localities along our coasts, the Fish Hawk is found nesting in colonies.

FIG. 9. AMERICAN OSPREY.

FAMILY STRIGIDÆ. BARN OWLS.

American Barn Owl (*Strix pratincola*). Occasionally found as far north as Massachusetts, and breeds from Long Island southward through Mexico. The Barn Owl is here a rare permanent resident. There are numerous records of its nesting, and it appears to have increased in numbers during recent years.

FAMILY BUBONIDÆ. HORNED OWLS, ETC.

***American Long-eared Owl** (*Asio wilsonianus*). A rather uncommon resident.

Short-eared Owl (*Asio accipitrinus*). Common during the migrations, and while a few probably breed, their is no definite record of their doing so.

***Barred Owl** (*Syrnium varium*). Next to the Screech Owl this is our commonest Owl. Its loud, sonorous hooting, *whoo, whoo, whoo, too-whoo, too whoo-ah*, is heard in the spring and again in late summer and is familiar to many who are not acquainted with its author.

FIG. 10. SHORT-EARED OWL.

Great Gray Owl (*Scotiaptex nebulosa*). In winter to the northern border of the United States. An individual shot near Mendham, N. J., is the only one which has been recorded from near New York City (Thurber, True Democratic Banner, newspaper, Morristown, N. J., Nov. 10, 1887).

***Saw-whet Owl** (*Crytoglaux acadica*). A regular and, in some localities, a not uncommon winter resident.

Screech Owl (*Megascops asio*). The Screech Owl is the commonest and best known of our Owls. It is present throughout the year. (See group, second floor).

SCREECH OWL
Group, Hall No. 208

Great Horned Owl' (*Bubo virginianus*). A rather rare resident. This is the only one of our Owls which habitually preys upon poultry, the others feed largely on field-mice and shrews.

***Snowy Owl** (*Nyctea nyctea*). An irregular winter visitant, sometimes occurring in considerable numbers.

Hawk Owl (*Surnia ulula caparoch*). There is apparently but one record of its capture in this vicinity, that of a specimen shot near Bay Ridge, L. I. (Dutcher Auk, X, 1893, p. 275).

Order COCCYGES. Cuckoos, etc.

Family CUCULIDÆ. Cuckoos, Anis, etc.

***Yellow-billed Cuckoo** (*Coccyzus americanus*). A common summer resident, arriving about May 10 and departing the last of September. (See group, third floor).

***Black-billed Cuckoo** (*Coccyzus erythrophthalmus*). A common summer resident arriving and departing at about the same time as the preceding species.

Family ALCEDINIDÆ. Kingfishers

***Belted Kingfisher** (*Ceryle alcyon*). A common summer resident, arriving the latter part of March and remaining until the streams and ponds, from which it obtains its food, are frozen.

Order PICI. Woodpeckers.

Family ALCEDINIDÆ. Kingfishers.

***Hairy Woodpecker** (*Dryobates villosus*). A rather uncommon resident.

***Downy Woodpecker** (*Dryobates pubescens medianus*) next to the Flicker, the Downy is our commonest Woodpecker .

Red-cockaded Woodpecker (*Dryobates borealis*). Southern United States, westward to Indian Territory, and northward to Tennessee and Virginia. This bird is accidental near New York, the only record of its occurrence being based on a specimen taken at Hoboken, N. J. (Lawrence, Ann. Lyc. Nat. Hist., VIII, 1866, p. 291).

***Yellow-bellied Woodpecker** (*Sphyrapicus varius*). A common spring and fall migrant.

Pileated Woodpecker (*Ceophlœus pileatus abieticola*). "Formerly whole wooded region of North America; now rare or extirpated in the more thickly settled parts of the Eastern States." This large Woodpecker occurs near New York only as a very rare straggler; there are no recent records.

FIG. 11. RED-HEADED WOODPECKER.

***Red-headed Woodpecker** (*Melanerpes erythrocephalus*). A summer resident of local distribution and a not uncommon and sometimes abundant migrant. Occasionally it is found in winter.

Red-bellied Woodpecker (*Centurus carolinus*). Eastern United States breeding from Florida to Virginia, and in the interior, to Ontario and Southern Dakota; occasionally strays to Massachusetts; winters from southern Ohio southward. Giraud speaks of this bird as breeding on Long Island, but it now occurs here only rarely and irregularly.

***Flicker: High-hole; Clape** (*Colaptes auratus luteus*). Our commonest Woodpecker. It is resident, but is much more common in the summer than in the winter, and is particularly numerous during its migrations in September and October.

ORDER MACROCHRIES. GOATSUCKERS, SWIFTS, ETC.

FAMILY CAPRIMULGIDÆ. GOATSUCKERS.

FIG. 12. NIGHTHAWK.

***Whip-poor-will** (*Antrostomus vociferus*). In some localities near New York City the Whip-poor-will is a common summer resident. It arrives about May 1 and leaves about October 1.

***Nighthawk** (*Chordeiles virginianus*). The Nighthawk is here a more or less common local summer resident. Even in New York City, where it has been known to lay eggs on the house-top, its characteristic note, *peent, peent,* uttered while it is coursing for food, is not infrequently heard. It arrives early in May and migrates southward in September and October, sometimes occurring at this season in large flocks.

FAMILY MICROPODIDÆ. SWIFTS.

***Chimney Swift** (*Chætura pelagica*). An abundant summer resident, arriving the latter part of April and remaining until October. (See group, second floor).

FAMILY TROCHILIDÆ. HUMMINGBIRDS.

***Ruby-throated Hummingbird** (*Trochilus colubris*). This, the only species of Hummingbird found in eastern North America, is here a common summer resident, arriving early in May and remaining until October.

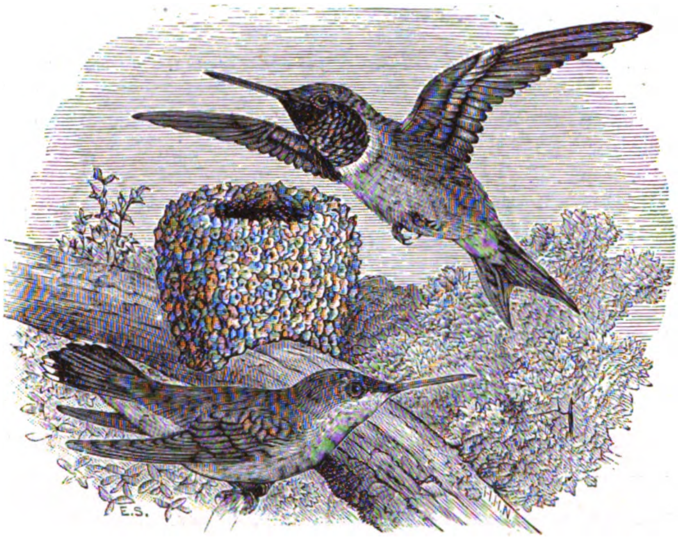


FIG. 13. RUBY-THROATED HUMMINGBIRDS AND NEST.

ORDER PASSERES. PERCHING BIRDS.

FAMILY TYRANNIDÆ. TYRANT FLYCATCHERS.

***Kingbird** (*Tyrannus tyrannus*). A common summer resident, arriving early in May and remaining until October. (See group, third floor).

Arkansas Kingbird (*Tyrannus verticalis*). A western species; the only records for this vicinity are those of a young male taken at Riverdale, N. Y., October 19, 1875. (Bicknell, Bull. N. O. C., IV, 1879, p. 60), and a specimen taken at Princeton, N. J., Sept. 29, 1894 (Phillips, Proc. D. V. O. C., II, p. 14).

***Great-crested Flycatcher** (*Myiarchus crinitus*). A common summer resident, arriving early in May and remaining until September.

***Phœbe** (*Sayornis phœbe*). A common summer resident arriving about March 20 and leaving early in November.

***Olive-sided Flycatcher** (*Nuttallornis borealis*). A migrant passing north in May, when it is apparently rare, and returning between the latter part of August and late September, when it is not uncommon.

***Wood Pewee** (*Horizopus virens*). A common summer resident of our woods, arriving about May 15 and remaining until the latter part of September.

***Yellow-bellied Flycatcher** (*Empidonax flaviventris*). A rather rare spring and not uncommon fall migrant, arriving in May and returning from its northern home early in August.

***Green-crested Flycatcher** (*Empidonax virescens*). A common summer resident of the Lower Hudson River Valley as far north as Sing Sing. On Long Island it apparently breeds on the north shore, while there are but two records for Connecticut, an adult taken at Suffield, June 24, 1874 (Merriam, Birds, Conn., p. 58) and a nest with young at Greenwich, June 25, 1893 (Voorhees, Auk, XI, 1894, p. 259). A rare summer resident in the vicinity of Plainfield, N. J. (Miller, MS). (See group, third floor).

Alder Flycatcher (*Empidonax traillí alnorum*). A rather rare migrant and a local summer resident. A nest and eggs, not fully identified, but with little doubt that of this species, was found by C. L. Brownell at Nyack, N. Y. At Plainfield, N. J., W. DeWitt Miller has found this species a locally common breeding bird (Auk, XVIII, 1901, p. 108; XX, 1903, p. 68).

***Least Flycatcher** (*Empidonax minimus*). A common summer resident; it arrives about May 1 and remains until late in September.

Family ALAUDIDÆ. Larks.

Skylark (*Alauda arvensis*). Individuals of this species have from time to time been liberated near New York City. In 1887 a small colony became established near Flatbush, L. I., where a nest containing young was found (Dutcher, Auk, V, 1888, p. 180). Without apparent increase these birds evidently manage to hold their own (Braislin, Auk, XVI, 1899, p. 191; Bildersee, Bird-Lore, VI, 1904, p. 204).

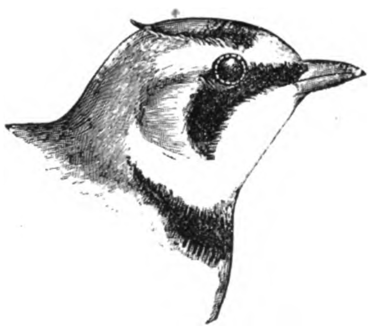


Fig. 14. Horned Lark.

Horned Lark; Shore Lark (*Otocoris alpestris*). A common winter resident along the coasts; less common or very rare in the Hudson Valley.

Prairie Horned Lark (*Otocoris alpestris praticola*). This small race of the Horned Lark is of rather rare occurrence in this vicinity. It is apparently extending its range eastward and there is one record of its having probably bred on Long Island (Dutcher, Auk, V, 1888, p. 180), where it also occurs during the winter.

FAMILY CORVIDÆ. CROWS, JAYS, MAGPIES, ETC.

***Blue Jay** (*Cyanocitta cristata*). A common resident, more numerous during the fall migration than at other times of the year.

The Canada Jay (*Perisorcus canadensis*), a northern species, is included by Lawrence in his "Catalogue of Birds" on the basis of an individual killed in July near Manhattanville, New York City. This specimen is now in the American Museum (No. 42,253). Its plumage is much worn and its toe-nails are abnormally long, facts which, taken in connection with the place and date of the bird's capture, induce me to believe that it had escaped from confinement.

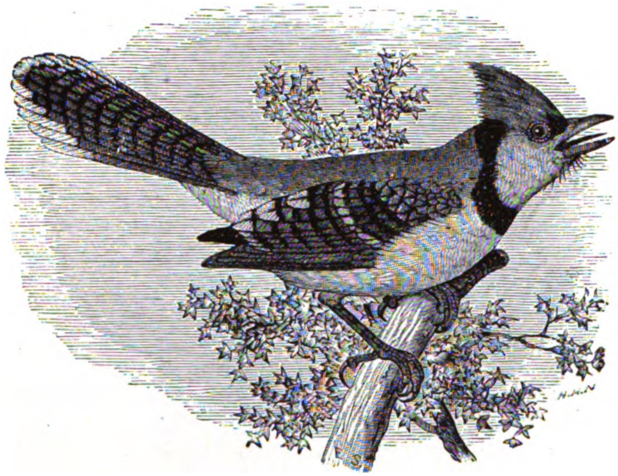


FIG. 15. BLUE JAY.

American Raven (*Corvus corax principalis*). Now of very rare occurrence in this vicinity. It is said to have been formerly common on the northern New Jersey coast (Lawrence), and is still uncommon along the southern coast of the State (Stone, Auk, XI, 1894, p. 137).

***American Crow** (*Corvus brachyrhynchos*). The Crow is here an abundant resident, but, as in the case of other species which are present the year round, it is probable that the individuals which summer with us pass the winter farther south, while our winter birds come to us from the north.

***Fish Crow** (*Corvus ossifragus*)). A common inhabitant of the Lower Hudson River Valley as far north as Sing Sing and occasionally reaches Highland Falls. In Connecticut it is of regular occurrence as far east as Stratford (Eames, Auk, VI, 1889, p. 338), while on Long Island its exact status appears to be unknown, though it is probably not uncommon. A few remain on the coast during the winter.

FAMILY STURNIDÆ. STARLINGS.

FIG. 16. STARLING, (SUMMER PLUMAGE).

***Starling** (*Sturnus vulgaris*). This Old World species has been introduced into this country on several occasions, but only the last importation appears to have been successful. The birds included in this lot were imported and released in Central Park, under the direction of Eugene Schieffelin of this city. They seem to have left the Park and to have established themselves in various places in the upper part of the city. A pair have bred for three successive seasons in the roof of this Museum. S. H. Chubb reports a pair nesting in a church at 122nd st. and Lenox avenue, and they also have nested at 100th st. and Riverside Drive. C. B. Isham tells me he has found their nest at Kingsbridge, New York City, and that he repeatedly observed a flock of fifty birds in the same locality during the late summer and fall of 1893 and 1894.

To the above statement, which stands as it appeared in the first (1894) edition of this List, may be added the further information, obtained from Mr. Schieffelin, that 80 Starlings were released on March 6, 1890, and 40 more on April 25, 1891. So far as I am aware the present (1906) boundary of the range of this species in America is marked by New Haven, Conn., on the east, Ossining, N. Y., on the north and Red Bank and Princeton, on the south. It is resident throughout the year, but gathers in flocks, sometimes containing several hundred birds, in the fall, when it wanders, about the country. Its economic status remains to be determined, but from the bird-

FIG. 17. STARLING, (WINTER PLUMAGE).

lover's point of view the Starling is a decided acquisition to the bird-life of our cities where its long-drawn, cheery whistle is in welcome contrast to the noisy chatter of House Sparrows.

FAMILY ICTERIDÆ. BLACKBIRDS, ORIOLES, ETC.

***Bobolink; Reedbird** (*Dolichonyx oryzivorus*). A locally distributed summer resident, arriving in early May and remaining until October. In August the males assume the Reedbird plumage and resort to our wild-rice marshes, where they are joined by large numbers from the north, which pause to feed on the wild-rice.

Twenty-five years ago the Bobolink was an abundant and generally distributed summer resident in this vicinity. Since that date it has rapidly decreased in numbers and is now entirely wanting in localities where it was formerly of regular occurrence.

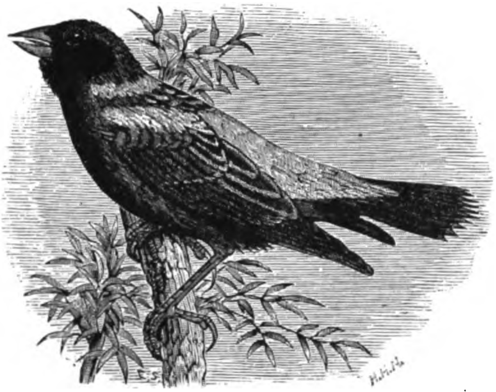


FIG. 18. BOBOLINK.

***Cowbird** (*Molothrus ater*). A common summer resident arriving late in March and remaining until November. It has been recorded as occurring in winter (Foster, Abst. Proc. Linn. Soc., No. 5, 1893, p. 2).

***Red-winged Blackbird** (*Agelaius phœniceus*). A common summer resident, abundant during the migrations when it occurs in large flocks. It is one of the first birds to reach us in the spring, frequently arriving before March 1, and it remains until December.

***Meadowlark** (*Sturnella magna*). A common summer resident, occuring in reduced numbers during the winter, when it is largely confined to the extensive marshes near the coast.

***Orchard Oriole** (*Icterus spurius*). A common summer resident, arriving early in May and remaining until September. (See group, third floor).

*__Baltimore Oriole__ (*Icterus galbula*). A somewhat more common summer resident than the preceding species. It arrives early in May and remains until September. (See group, third floor).

*__Rusty Blackbird__ (*Euphagus carolinus*). A common migrant, passing northward in March, returning in September and sometimes remaining during the winter.

FIG. 19. RED-WINGED BLACKBIRD.

*__Purple Grackle: Crow Blackbird__ (*Quiscalus quiscula*). A common summer resident of local distribution, nesting in colonies. It is one of our earliest migrants, arriving from the south with the Red-winged Blackbird about March 1. During the breeding season it is not seen far from the vicinity of its nest, but about July 1, when the young are on the wing, the birds gather in small flocks and wander over the country, pausing wherever they find an abundance of food. These flocks gradually coalesce and, in October and November, form enormous gatherings numbering thousands of birds.

*__Bronzed Grackle__ (*Quiscalus quiscula æneus*). A spring and fall migrant, sometimes not uncommon.

FAMILY FRINGILLIDÆ. FINCHES, SPARROWS, ETC.

Evening Grosbeak (*Hesperiphona vespertina*). During the winter and early spring of 1890 there was a phenomenal incursion of Evening Grosbeaks into the northern United States. The most southern record of their occurrence in the Atlantic States was at Summit, N. J., where, on March 6, Mr. W. O. Raymond observed a flock of eight birds (Orn. and Oöl., XV, 1890, p. 46), No specimens were collected, but Mr. Raymond watched the birds for some time at a distance of about eight feet, and he has since examined skins of the species in this Museum, thus confirming his identification.

***Pine Grosbeak** (*Pinicola enucleator leucura*). This species occurs here in the winter and then only at irregular intervals. It last appeared in numbers during the winter of 1903-4 when it was first observed at Englewood, N. J., Oct. 25 (Chapman, Bird-Lore, V, 1903, p. 199).

FIG. 20. PINE GROSBEAK.

***House Sparrow; English Sparrow** (*Passer domesticus*). From the report of the Division of Economic Ornithology of the Department of Agriculture (Washington, 1889), we learn that English Sparrows were first introduced into New York City in 1860, when twelve birds were released in Madison Square. In 1864 they were introduced in Central Park, and in 1866 two hundred were set free in Union Park. From these, and one or two other small additional importations of a few pairs each, have descended the countless numbers of Sparrows which to-day inhabit our streets and parks. In this latitude the English Sparrow has been known to rear six broods in a season, and their marvelous rate of increase is graphically given in a table in the report already mentioned, which shows that in ten years the progeny of a single pair might amount to 275,716,983,698.

With the discordant notes of these ubiquitous little pests constantly in our ears we may read with mixed humor and regret the following quotation from Lawrence's Catalogue of New York Birds (Ann. Lyc. Nat. Hist., VIII, 1866, p. 287): "I first observed them in the spring of 1865. A friend, conversant with our local native birds, informed me that he had seen a species in the shrubbery around the church on the corner of 5th avenue and 29th street, with which he was not familiar; on going to ascertain what they were, to my surprise I found them to be House Sparrows; they were domiciled in the ivy which grew on the walls of the church, and were quite gentle and fearless, some alighting in the street and dusting themselves quite near to where I stood."

***The European Chaffinch** (*Fringilla cœlebs*), several pairs of which were released in Central Park under the direction of Eugene Schieffelin in 1890, is occasionally observed in Central Park where three individuals appear to exist at present. Whether, however, they are the descendants of the introduced birds or escaped cage-birds is unknown.

***The Greenfinch** (*Chloris chloris*) a European species was observed in Central Park, May 17, 1903, by C. G. Abbott.

***Purple Finch** (*Carpodacus purpureus*). In the vicinity of New York City the Purple Finch is a rather rare summer resident, a very common migrant and irregular winter resident. It is apparently increasing in numbers during the summer on Long Island (Dutcher, MS).

***American Crossbill** (*Loxia curvirostra minor*). A regular winter visitant. This erratic species has on several occasions been found breeding south of its regular breeding range. Such an instance occurred at Riverdale, N. Y., where it was found nesting on April 22, 1874 (Bicknell, Bull. N. O. C., IV, 1880, p. 7).

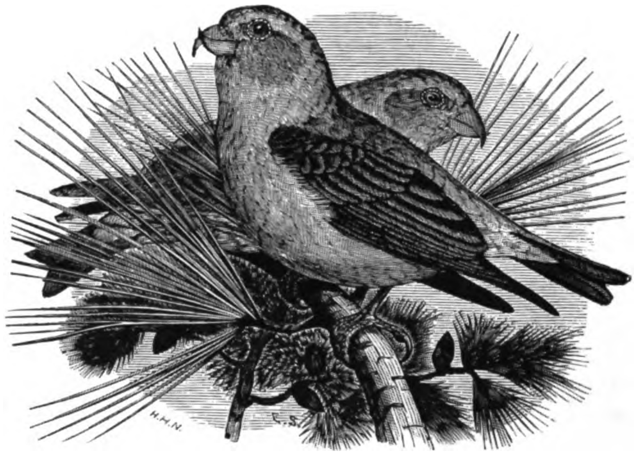


FIG. 21. AMERICAN CROSSBILL.

***White-winged Crossbill** (*Loxia leucoptera*). Of more rare and irregular occurrence in winter than the preceding species. This and the preceding species last occurred in numbers during the winter of 1899-1900 (Chapman Bird-Lore, II, 1900, pp. 25, 59).

Redpoll (*Acanthis linaria*). This species is here an irregular winter visitant, sometimes occurring in considerable numbers.

Greater Redpoll (*Acanthis linaria rostrata*). Two specimens taken at Sing Sing, N. Y., are the only individuals of this species which have been recorded from this vicinity (Fisher, Bull, N. O. C., VIII, 1883, p. 121).

The European Linnet (*Acanthis cannabina*) is recorded from Scarboro, N. Y. (G. H. Thayer, Auk, XVII, 1900, p. 389); but the large number of cage-birds of this species annually imported into this country makes it probable that the bird secured was an assisted immigrant.

FIG. 22. REDPOLL.

***American Goldfinch** (*Astragalinus tristis*). The Goldfinch, Yellowbird, or Thistlebird, is a common resident here.

FIG. 23. AMERICAN GOLDFINCH.

***European Goldfinch** (*Carduelis carduelis*). A European species which was introduced into this country at Hoboken, N. J., in 1878. The following year it appeared in Central Park and has since spread over the upper parts of the city where in favorable localities it is not uncommon. It is with us throughout the year. (Adney, Auk, III, 1886, p. 409).

***Pine Siskin; Pine Finch** (*Spinus pinus*). A more or less common fall and winter visitant. On two occasions it has been found nesting in the Lower Hudson Valley, at Sing Sing, May 25, 1883 (Fisher, Bull. N. O. C., VIII, 1883), and at Cornwall-on-Hudson, May 12, 1887 (Allen, Auk, IV, 1887, p. 284). (See group, third floor).

***Snowflake; Snow Bunting** (*Passerina nivalis*). On Long Island this bird is an abundant winter resident on the sand-flats near the ocean (Dutcher, MS). In the Lower Hudson Valley it is much less common.

Lapland Longspur (*Calcarius lapponicus*). A rare winter resident; sometimes found with flocks of the preceding, but more frequently associated with Horned Larks.

Chestnut-collared Longspur (*Calcarius ornatus*). "Interior of North America, from the Saskatchewan Plains south to Texas." A specimen of this western species was taken at Long Island City, February 16, 1889 (Hendrickson, Auk, VI, 1889, p. 190).

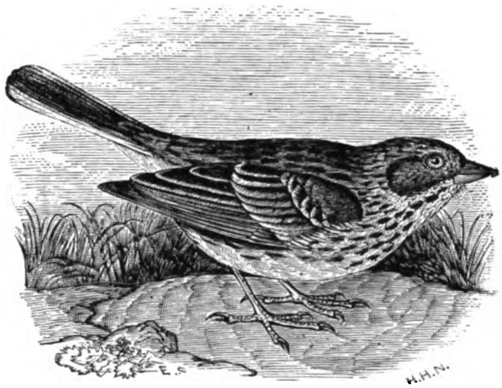


FIG. 24. VESPER SPARROW.

***Vesper Sparrow; Grass Finch: Bay-winged Bunting** (*Poœcetes gramineus*). A common summer resident, arriving about April 1, and remaining until the latter part of November.

Ipswich Sparrow (*Passerculus princeps*). A common winter resident, confined strictly to the immediate vicinity of the coasts, where it is found from the middle of October to the first of April (Dutcher, Auk, III, 1886, p. 441).

***Savanna Sparrow** (*Passerculus sandwichensis savanna*). This species is here a rare summer resident and abundant migrant, arriving about April 1 and departing in November and December. It breeds at Morristown, N. J. (Thurber) and is said to remain throughout the winter in the salt-marshes at Bridgeport, Conn. (Averill) Braislin, (Auk, XVI, 1899, p. 192) records it from Garden City, L. I., July 17, 1897. and Flatbush, L. I., Jan. 30, 1895.

Grasshopper Sparrow; **Yellow-winged Sparrow** (*Coturniculus savannarum passerinus*). Locally a common summer resident, arriving about May 1 and remaining until October.

Henslow Sparrow (*Ammodramus henslowi*). In this vicinity the Henslow sparrow has been found in but few localities where, however, it is apparently not uncommon. It is recorded as breeding at Morristown, N. J. (Thurber), and Boonton, Morris County, N. J. (Judd, Auk, XIV, 1897, p. 326). Summer resident in small numbers near Plainfield, N. J. (Miller, MS).

Sharp-tailed Sparrow (*Ammodramus caudacutus*). An abundant summer resident; with the exception of a colony on the Hudson at Piermont, confined entirely to the salt marshes of our coasts. (See group, third floor).

Nelson Sharp-tailed Sparrow (*Ammodramus nelsoni*). This species is known here only as a rather-rare fall migrant in the Hudson River Valley, occurring from the latter part of September to the latter part of October.

Acadian Sharp-tailed Sparrow (*Ammodramus nelsoni subvirgatus*). Occurs with the preceding. (On the distribution of the Sharp-tailed Sparrows see Dwight, Auk, XIII, 1896, p. 275).

FIG. 25. SEASIDE SPARROW.

Seaside Sparrow (*Ammodramus maritimus*). This is an even more abundant summer resident than the Sharp-tailed Sparrow and, like it, is confined exclusively to our coasts, with the exception of a colony in the Piermont marshes. (See group, third floor).

Lark Sparrow (*Chondestes grammacus*). Interior of North America, eastward to Illinois, breeding from Texas to Manitoba; accidental on the Atlantic coast. There are two records for this vicinity, Sayville, L. I., August 20, 1879 (Earle, Bull. N. O. C., VI, 1881, p. 58) and Schraalenburg, N. J., November 26, 1885 (Chapman, Auk, III, 1886, p. 136).

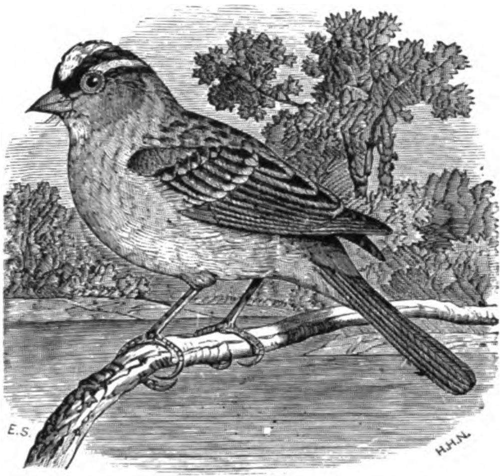


FIG. 26. WHITE-CROWNED SPARROW.

***White-crowned Sparrow** (*Zonotrichia leucophrys*). A rather rare migrant passing norhtward in May and returning in October. Braislin (Auk, XV, 1898, p. 59) records a specimen taken at Parkville, L. I., April 10, 1897.

***White-throated Sparrow** (*Zonotrichia albicollis*). An abundant migrant and locally common winter resident. It arrives from the north the latter part of September and remains with us until the middle of May.

***Tree Sparrow** (*Spizella monticola*). An abundant winter resident, arriving from the north about November 1 and remaining until April.

FIG. 27. WHITE-THROATED SPARROW.

***Chipping Sparrow; Chippy** (*Spizella socialis*). An abundant summer resident, arriving from the south about April 1 and remaining until November.

***Field Sparrow** (*Spizella pusilla*). An abundant summer resident, appearing in the spring about April 1 and not departing southward until November or even December. Of rare but regular occurrence in winter at Plainfield, N. J. (Miller, MS). (See group, third floor).

***Junco; Snowbird** (*Junco hyemalis*). The Junco is one of our most abundant winter birds. It comes to us from the north late in September and remains until May.

FIG. 28. JUNCO.

***Song Sparrow** (*Melospiza cinerea melodia*). An abundant summer and common winter resident. (See group, third floor).

Lincoln Sparrow (*Melospiza lincolni*). In this vicinity the Lincoln Sparrow is a rare but regular migrant, passing northward in May and southward in September and October.

***Swamp Sparrow** (*Melospiza georgiana*). An abundant summer resident, especially in the great marshes of the Hackensack, and a rare winter resident. (See group, third floor).

***Fox Sparrow** (*Passerella iliaca*). A common spring and fall migrant, passing northward in March and April and southward in October and November. There are several winter records for Princeton, N. J. (Scott, Bull, N. O. C., IV, 1879, p. 82).

***Towhee; Chewink** (*Pipilo erythrophthalmus*). An abundant summer resident, arriving about April 20, remaining until late October, and rarely into the winter. (See group, second floor).

***Cardinal** (*Cardinalis cardinalis*). The vicinity of New York City is about the northern limit of the Cardinal's range on the Atlantic coast. It is here a not uncommon resident of local distribution. In the Hudson Valley it is rarely found north of Hastings and Nyack; it is very rare eastward along the sound, and also on Long Island, but is common in Central Park, New York City, where I have seen nine individuals at one time. (See group, second floor).

***Rose-breasted Grosbeak** (*Zamelodia ludoviciana*). A common summer resident in the Hudson River Valley, arriving about May 1 and remaining until October. On Long Island it is a rare summer resident (Dutcher, MS). (See group, second floor).

***Blue Grosbeak** (*Guiraca cærulea*). There are several records of this southern bird's occurrence in this vicinity. It has been taken at Canarsie, L. I., May, 1843 (Dutcher, Auk, V, 1893, p. 276); Morristown, N. J. (Thurber, True Democratic Banner, newspaper, Nov. 17, 1889); Snake Hill, N. J. (Bicknell, Bull. N. O. C., III, 1878, p. 132), and Manhattan Island (DeKay, Birds, N. Y., p. 146).

***Indigo Bunting** (*Cyanospiza cyanea*). A common summer resident in this vicinity, arriving about May 1 and remaining until October 1.

Painted Bunting (*Cyanospiza ciris*). Breeds from the Gulf States northward to Kansas, southern Illinois and North Carolina. The capture of several specimens of this bird in this vicinity has been recorded (Bicknell, Bull. N. O. C., III, 1878, p. 132). It is possible that they were escaped cage-birds.

Dickcissel; Black-throated Bunting (*Spiza americana*). Eastern United States, mostly in the Mississippi Valley, breeding from Texas to Minnesota, and wintering in Central and South America. Breeds east of the Alleghanies now only rarely and locally. About forty years ago this bird was evidently a regular and not uncommon summer resident in this vicinity. (See Giraud, Chapman *apud* Galbraith, Auk, VIII, 1891, p. 395), but it occurs now only rarely and irregularly. Recent records are: Miller's Place, L. I., September 29 and October 10 (Dutcher, Auk, VI, 1889, p. 13) and Blithewood, L. I., August 25 (Johnson, Auk, VIII, 1891, p. 116). In July, 1904, W. De Witt Miller found a pair of this species breeding at Plainfield, N. J. (Auk, XXI, 1904, p. 487). J. Dwight, Jr., records the occurrence of a male Dickcissel at Kingston, N. Y., June 5, 1897 (Auk, XIV, 1897, p. 95).

Family TANAGRIDÆ. Tanagers.

Western Tanager (*Piranga ludoviciana*). Western North American north to British Columbia. The only record of the occurrence of this western species in this vicinity is that of a young male taken at Fort Montgomery, N. Y., December 21, 1881 (Mearns, Auk, VII, 1890, p. 55).

***Scarlet Tanager** (*Piranga erythromelas*). A common summer resident, arriving early in May and remaining until about October 1. (See group, third floor).

Summer Tanager (*Piranga rubra*). Eastern United States, breeding from Florida to southern New Jersey, wandering casually to Nova Scotia, and wintering in Central and South America. This species is of rare and irregular occurrence in this vicinity. (Hendrickson, Auk, 1, 1885, p. 290; Dutcher, Auk, III, 1886, p. 412; XIX, 1902, p. 291; V, 1888, p. 181; Mearns, Auk, VII, 1890, p. 55; Braislin, Auk, XIX, 1902, p. 147).

FAMILY HIRUNDINIDÆ. SWALLOWS.

***Purple Martin** (*Progue subis*). This bird breeds in colonies and is of local distribution during the breeding season. It was formerly not uncommon in the vicinity of New York City, but the English Sparrows have taken possession of its nesting-houses, and at present it is found in but few places.

***Cliff Swallow; Eave Swallow** (*Petrochelidon lunifrons*). Like most of the Swallows it nests in colonies, and in this region generally places its mud nests beneath the projecting eaves of a barn. It appears to be less common during the summer than it was twenty or more years ago, but is a common migrant particularly in the fall. According to Mearns, it arrives as early as April 16. (See group, second floor).

***Barn Swallow** (*Hirundo erythrogaster*). A common summer resident and abundant fall migrant. It arrives about April 20 and remains until October 1.

***Tree Swallow** (*Iridoprocne bicolor*). Arrives from the south early in April. There are a few recorded instances of its breeding near New York City, but, generally speaking, it passes northward to more distant nesting grounds. July 1 the birds begin to return from the north, making their home in the marshes of the Hackensack, where, by July 20, they may be found in countless numbers. In the morning they leave their roosts in the "cat-tails" and fly out over the adjoining country to feed. At night they return. Their numbers increase until about September 1, then decrease, and by October 20 only a few stragglers remain.

***Bank Swallow** (*Riparia riparia*). A locally common summer resident, breeding in colonies where the conditions are favorable. It arrives about May 1 and remains until October. (See group, second floor).

Rough-winged Swallow (*Stelgidopteryx serripennis*). This Swallow is locally common in the Lower Hudson River Valley, at Riverdale (Bicknell), Hastings-on-the-Hudson (Rowley), Sing Sing (Fisher); at Highland Falls, which seems to be near the northern limit of its range in the Hudson Valley, it is a rare summer resident (Mearns). I have seen it near Ramapo, N. Y., and with J. Dwight, Jr., found a small colony breeding at Port Jervis, N. Y. It breeds near New Haven, Connecticut, in small numbers, and is rare as far north as Hartford (Sage). On Long Island it is of rare and irregular occurrence (Dutcher).

FAMILY AMPELIDÆ. WAXWINGS, ETC.

Bohemian Waxwing (*Ampelis garrulus*). This species occurs here only as an exceedingly rare and irregular winter visitant. There are no recent records

***Cedar Waxwing; Cedarbird** (*Ampelis cedrorum*). A common summer resident; occurring irregularly in the winter.

FAMILY LANIIDÆ. SHRIKES.

***Northern Shrike; Butcherbird** (*Lanius borealis*). A more or less regular but rather uncommon winter resident.

FIG. 29. NORTHERN SHRIKE.

Migrant Shrike (*Lanius ludovicianus migrans*). The Migrant Shrike is found here is a rare but regular migrant during April, the latter part of August and in September, and, rarely, until December. It has been known to breed but once, at Sing Sing, N. Y., where a fledgeling was taken June 16, 1877 (Fisher, Bull. N. O. C., IV, 1879, p. 61).

FAMILY VIREONIDÆ. VIREOS.

***Red-eyed Vireo** (*Vireosylva olivacea*). This is one of our abundant summer residents. It arrives from the south about May 8 and remains until October. (See group, third floor).

Philadelphia Vireo (*Vireosylva philadelphica*). A very rare migrant.

***Warbling Vireo** (*Vireosylva gilva*). A common summer resident of local distribution, arriving early in May. (See group, third floor).

***Yellow-throated Vireo** (*Lanivireo flavifrons*). A common summer resident, arriving about May 7 and remaining until the latter part of September.

***Blue-headed Vireo** (*Lanivireo solitarius*). A not uncommon migrant, passing northward during the latter part of April and first part of May, and returning late in September.

***White-eyed Vireo** (*Vireo noveboracensis*). A common summer resident about New York City. It reaches us from the south about May 7, and remains until early October. (See group, third floor).

FAMILY MNIOTILTIDÆ. WOOD-WARBLERS.

***Black and White Warbler** (*Mniotilta varia*). A rather common summer resident and common migrant. It appears the latter part of April and is with us until the first part of October. (See group, third floor).

Prothonotary Warbler (*Protonotaria citrea*). Eastern North America, breeding from the Gulf States to southern Illinois and Virginia, and wintering in the tropics. Its occurrence near New York City is accidental; there are but two records, viz., a male shot at Jamaica, L. I. (Dutcher, Auk, X, 1893, p. 276), and a male seen by E. P. Bicknell near the northern limit of New York City, June 2, 1895 (Auk, XII, 1895, 306). Dutcher has recorded a specimen which struck the Montauk Point Lighthouse, August 27, 1886 (Auk, V, 1888, p. 182).

***Worm-eating Warbler** (*Helmitheros vermivorus*). This bird is one of our rarer summer residents, though it is not uncommon some years in the early fall migration. In the Hudson River Valley it is regularly found as far north as Highland Falls (Mearns) and occurs at Fishkill (Stearns). In Connecticut it breeds at Saybrook and New Haven, but is not common, and at Portland it has been taken only twice (Sage). On Long Island it is considered exceedingly rare (Dutcher).

***Blue-winged Warbler** (*Helminthophila pinus*). This species arrives early in May and remains until September 1. It is a common summer resident of the Lower Hudson Valley, at least as far north as Highland Falls (Mearns). In Connecticut it is common at Saybrook and New Haven, but is rare as far north as Portland, where but one or two pairs breed each season (Sage). On Long Island it is known to breed only along the north shore, where it is probably not uncommon in favorable localities. Mrs. E. G. Britton records the occurrence of an individual of this species in Bronx Park in January, 1900 (Bird-Lore, II, 1900, p. 26; see also Noble, Bird-Lore, II, 1900, p. 59). (See group, third floor).

Brewster's Warbler (*Helminthophila leucobronchialis*) with us is a rare but regular summer resident in northern New Jersey, the Lower Hudson Valley and southern Connecticut, but has been taken only once on Long Island (Howell). Specimens have been recorded from Morristown (Thurber), Maplewood (Riker), and Englewood, N. J., where it has been found nesting (Chapman, Auk, IV, 1887, p. 348; IX, 1892, p. 302). Farther north in the Hudson Valley it has been found at Nyack (Bicknell), and at Sing Sing five specimens have been secured (Fisher, Bull. N. O. C., IV, 1879, p. 234; VI, 1881, p. 245; Auk, II, 1885, p. 378) In the Lower Connecticut Valley this bird seems to be more frequent than in any other part of its range. It has been found at Saybrook, Seymour, New Haven, Portland and other localities, the principal records being as follows: Eames, Auk, V, 1888, p. 427; VI, 1889, p. 305; Bishop, Auk, VI, 1889, p. 192; Sage, Auk, X, 1893, p. 208. Probably not more than one-third of all the specimens recorded are typical *leucobronchialis*, the remaining two-thirds presenting every stage of intergradation between this bird and typical *H. pinus*.

Lawrence's Warbler (*Helminthophila lawrencei*) is a much rarer bird than the preceding. There are records for only six specimens from the immediate vicinity of New York City, viz. Chatham, N. J. (Herrick), Hoboken, N. J. (Lawrence), Rye, N. Y. (Vorhees, Auk, V, 1888, p. 427), Greenwich, Conn. (Vorhees, Auk, XI, 1894, p. 259), Cold Spring Harbor, L. I. (Braislin, Auk, XX, 1903, p. 53), and New York Zoological Park, where a male was found breeding with a female *pinus* (Bildersee, Bird Lore, VI, 1904, p. 131; Beebe, Auk, XXI, 1904, p. 387).

The status of both Brewster's and Lawrence's Warblers is still unsettled. They are generally considered to be hybrids between *H. pinus* and *H. chrysoptera*, and it has also been suggested that dichromatism may play a part in producing their coloration. Their relationship will be found discussed under the following references: Brewster, Bull. N. O. C., VI, 1881, p. 218; Ridgway, Auk, II, 1885, p. 359; Manual N. A. Birds, 1887, p. 486; Birds of North and Middle America, II, 1902, pp. 452, 453; Thayer, Auk, XIX, 1902, p. 401; Bishop, Auk, XXII, 1905, p. 21).

***Golden-winged Warbler** (*Helminthophila chrysoptera*). In the immediate vicinity of New York City, this bird occurs as a rather rare spring migrant, but in the early southward migration, in August, it is sometimes not uncommon. It has been found nesting at Nyack, N. Y. (Brownell) and probably breeds regularly from that point northward.

***Nashville Warbler** (*Helminthophila rubricapilla*). This species is here a rather common migrant and a rare summer resident as far south as Highland Falls. It arrives about May 10 and returns on its southward journey during late August, the last migrants being seen about September 25. A breeding female was taken by Chapman at Englewood, N. J., June 16, 1887, (Auk, VI, 1889, p. 304).

Orange-crowned Warbler (*Helminthophila celata*). This Warbler occurs here as an exceedingly rare migrant. There are records of only six specimens, all but one of which occurred in the fall. (Howell, Auk, X, 1893, p. 91).

***Tennessee Warbler**(*Helminthophila peregrina*). With us this bird is a rather rare spring migrant but is sometimes not uncommon in the fall. It passes northward early in May and returns on its southward journey in September.

***Northern Parula Warbler** (*Compsothlypis americana usneæ*). The Parula Warbler is here a more or less abundant migrant and local summer resident. It arrives from the south about May 7 and the last individuals are observed in early October.

***Cape May Warbler** (*Dendroica tigrina*). This is one of our rarest spring migrants, passing northward about May 15. In the fall migration immature birds are sometimes not uncommon.

***Yellow Warbler** (*Dendroica æstiva*). A common summer resident. It arrives from the south about May 5 and remains until September. (See group, third floor).

***Black-throated Blue Warbler** (*Dendroica cærulescens*). A common migrant, passing northward early in May and returning in September.

FIG. 30. MYRTLE WARBLER.

***Myrtle Warbler; Yellow-rumped Warbler;** (*Dendroica coronata*). An abundant migrant in our vicinity and in favorable localities where bayberries are abundant, it passes the whole winter. Migrants begin to arrive in early April, and the southward migration takes place during the latter part of September and October.

***Magnolia Warbler** (*Dendroica maculosa*). In this vicinity it is a common migrant, passing northward early in May and returning late in August and in September.

Cerulean Warbler (*Dendroica cerulea*). Breeds in the Mississippi Valley as far north as Minnesota, and eastward as far as Cayuga Co., N. Y., and winters in the tropics. Its occurrence here is accidental, and there are but three records of its capture, one of a male taken in Kings County, L. I., (Dutcher, Auk, X, 1893, p. 277), of a male taken at Highland Falls, May 17, 1875 (Mearns, Birds Hudson Highlands, p. 154), and one of a specimen taken at Boonton, Morris Co., N. J., in September, 1887 (Judd, Auk, XIV, 1897, p. 326).

***Chestnut-sided Warbler** (*Dendroica pensylvanica*). With us it is a common migrant, and, in recent years, has become a locally common summer resident. It arrives early in May, and the return migration occurs between August 10 and October 1.

***Bay-breasted Warbler** (*Dendroica castanea*). As a rule the Bay-breasted is one of our rarest transient Warblers but during some seasons it is found in numbers. It passes northward about the middle of May and returns in September.

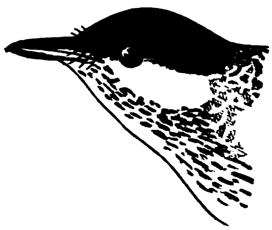


FIG. 31. BLACKPOLL WARBLER.

***Blackpoll Warbler** (*Dendroica striata.*) The Blackpoll is one of our most abundant migrants and is the last of the transient Warblers to pass northward in the spring. It arrives from the south about May 7 and returns on its southern journey in September.

***Blackburnian Warbler** (*Dendroica. blackburniæ*). A rather uncommon spring migrant, passing northward during the first of May, but is not uncommon some year during its return migration in September.

Yellow-throated Warbler (*Dendroica domina*). Southern United States, breeding as far north as Virginia and wintering from Florida southward. There is but one record of the occurrence of this southern species near New

York City. It is based on the capture of a male in Kings County, L. I. (Dutcher, Auk, X, 1893, p. 277).

***Black-throated Green Warbler** (*Dendroica virens*). In the immediate vicinity of New York City this bird is found chiefly as a migrant, arriving from the south late in April and returning about the middle of August. It is known to breed at Highland Falls, N. Y. (Mearns), Bridgeport, Conn. (Averill), Millers Place, L. I. (Dutcher, MS), and at Demarest, N. J., where on June 5, 1904. B. S. Bowdish found a nest built in a skunk cabbage about fourteen inches from the ground (Auk, XXIII, 1906, p. 17).

***Pine Warbler** (*Dendroica vigorsi*). This Warbler is of local distribution in this vicinity. In northern New Jersey, the Lower Hudson Valley and southern Connecticut it occurs only as a rare migrant, but on certain parts of Long Island, where the scrub pines afford it congenial surroundings, it is not uncommon and breeds.

Palm Warbler (*Dendroica palmarum*). This species is of rather rare but regular occurrence here. One specimen was taken at Sing Sing, N. Y., April 29, 1882 (Fisher, Bull. N. O. C., VII, 1882, p. 249), two at Riverdale, N. Y., in the spring of 1877 (Bicknell, Bull. N. O. C., V. 1880, p. 182), and one struck the Fire Island Lighthouse, September 23, 1887 (Dutcher, Auk, V, 1888, p. 182). Braislin (Auk, XIX, 1902, p. 149) records it as "common" near Brooklyn between September 25 and October 7, 1895, and Miller (Bird-Lore, V, 1903, p. 199) states that it was rather common near Plainfield, N. J., between September 22 and October 4, 1903.

***Yellow Palm Warbler; Yellow Redpoll** (*Dendroica palmarum hypochrysea*). A common migrant arriving from the south about April 10, and returning late in September and in October.

***Prairie Warbler** (*Dendroica discolor*). The distribution of the Prairie Warbler in this vicinity is much like that of the Pine Warbler. It is rare in northern New Jersey and the Lower Hudson Valley, where however, it has been found breeding once (Highland Falls. Mearns), but is not uncommon on some parts of Long Island. At Bridgeport, Conn., it is a common migrant and may breed (Averill). (See group, third floor).

Fig. 32. Ovenbird.

***Ovenbird** (*Seiurus aurocapillus*). The Ovenbird is one of our abundant summer residents, arriving about May 1 and remaining until the middle of October. (See group, third floor).

Northern Water-thrush (*Seiurus noveboracensis*). A common migrant, passing northward during May and returning about September 1. Cherrie (Auk, XIX, 1902, p. 210) records the probable breeding of this species at Cold Spring Harbor, L. I.

LOUISIANA WATER THRUSH
Group, Hall No. 308

Grinnell's Water-thrush (*Seiurus noveboracensis notabilis*). Western North America; eastward during the migrations to Virginia and South Atlantic States. This western species has been recorded only from Raritan, N. J., May 30, 1889 (Southwick, Auk, IX, 1892, p. 303), and Princeton, N. J. Sept. 10, 1879 (Babson).

Louisiana Water-thrush (*Seiurus motacilla*). It is a common summer resident in the lower Hudson Valley, where it has been found as far north as Lake George (Fisher), and is not uncommon in the lower Connecticut Valley. There are two records for Massachusetts and two for Rhode Island. On Long Island it is very rare (Dutcher). (See group, third floor).

FIG. 33. KENTUCKY WARBLER.

***Kentucky Warbler** (*Opornis formosa*). This is a common summer resident on the banks of the Lower Hudson River and has been recorded from Fort Lee and Riverdale (Bicknell), Englewood (Chapman), and Sing Sing (Fisher), beyond which point it is as yet unknown. In Connecticut there are but three records, viz: at Suffield where a male was taken August 16, 1876 (Merriam), at Greenwich, where a pair and a fledgeling were seen and the male taken July 10, 1892 (Voorhees, Auk, X, 1893, p. 86) and at West Stratford, where a male was shot May, 30, 1888 (Lucas, Orn. and Ool., XIV, 1889, p. 62). On Long Island it is very rare, there being but one recent record if its occurrence (Dutcher). It is wholly absent in the vicinity of Plainfield, N. J., (Miller) and at Princeton (Babson).

Connecticut Warbler (*Oporornis agilis*). This species is an exceedingly rare spring migrant east of the Alleghanies, and I know of no record of its occurrence here at that season; in the fall, however, it is not uncommon, and sometimes is abundant, arriving as early as September 3 and remaining until the latter part of the month.

***Mourning Warbler** (*Oporornis philadelphia*). This species is one of our rare Warblers; it passes northward during the latter half of May.

***Northern Yellowthroat** (*Geothlypis trichas brachidactyla*). One of our most abundant summer residents. It arrives about May 5 and remains until October. (See group, third floor.)

***Yellow-breasted Chat** (*Icteria virens*). A common summer resident, arriving about May 5 and remaining until September.

***Hooded Warbler** (*Wilsonia mitrata*). The Hooded Warbler is here near the northern limit of its range. At Englewood, N. J., it is an abundant summer resident, arriving about May 5, and remaining until the middle of September. At Riverdale, N. J., it is locally common (Bicknell), at Sing Sing it is not common (Fisher), but at Highland Falls it is "very common" (Mearns). It has been taken at Fishkill, the most northern point in the

Hudson River Valley from which it has been recorded. In Connecticut it is common at Saybrook and New Haven, but is rare north of these points (Sage). In Massachusetts it has been found only twice. On Long Island it is rare. At Plainfield and Princeton, N. J., it is a rare migrant.

***Wilson's Warbler** (*Wilsonia pusilla*). This bird is here a rather uncommon spring migrant, passing northward from the 12th to the 30th of May, but is not uncommon at times during its return journey, which takes place between August 15 and September 15.

***Canadian Warbler** (*Wilsonia canadensis*). A common migrant, passing north from May 10 to June 10 and returning between August 5 and September 10.

***American Redstart** (*Setophaga ruticilla*). A common summer resident of our woodland; it arrives about May 5 and remains until early October. (See group, third floor.)

FAMILY MOTACILLIDÆ. WAGTAILS.

***American Pipit; Titlark** (*Anthus pensilvanicus*). The Titlark is a generally common, and, along our coasts, an abundant migrant. It travels northward from the latter part of March to early May and returns on its southern journey during October and November.

FAMILY MIMIDÆ. MOCKINGBIRDS, THRASHERS, ETC.

***Mockingbird** (*Mimus polyglottos*). Breeds from the Bahamas and Mexico to southern Illinois and northern New Jersey, rarely to Massachusetts, and winters from North Carolina southward. The Mockingbird is of rare occurrence in this vicinity and doubtless many of the specimens reported are escaped cage-birds. It has, however, been found breeding at several localities, and at Tenafiy, N. J., a pair returned to the same locality for several years (Auk, VI, 1889, p. 305). On several occasions Mockingbirds have been found here during the winter and have shown their ability to withstand our coldest weather as long as they can obtain an abundance of food.

***Catbird** (*Galeoscoptes carolinensis*). An abundant summer resident, arriving about May 3 and remaining until October 20. (See group, third floor.)

***Brown Thrasher** (*Toxostoma rufum*). A common summer resident, appearing about April 20 and remaining until the middle of October and occasionally later. (See group, second floor.)

FAMILY TROGLODYTIDÆ. WRENS.

***Carolina Wren** (*Thryothorus ludovicianus*). Eastern United States, breeding from the Gulf States to southern Iowa, northern Illinois, and southern Connecticut; resident, except at the northern limit of its range. Generally speaking the Carolina Wren is a rather rare bird in this vicinity but on the

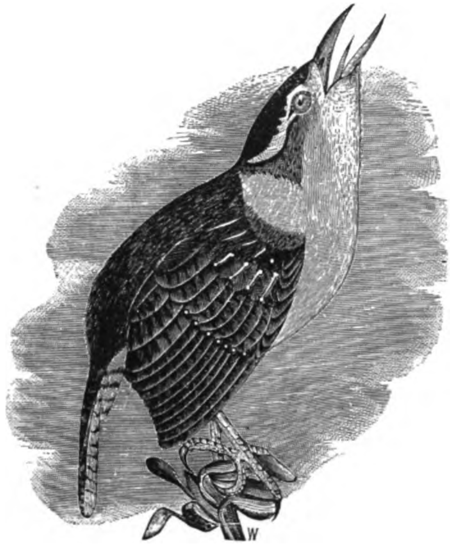


FIG. 34. CAROLINA WREN.

eastern slope of the Palisades, as far north as Piermont, N. Y., it is common during the summer (Chapman, Auk, X, 1893, p. 87). It has been found on Long Island in the winter (Dutcher, MS). Since the above was written, in 1894, this species appears to have increased in numbers, locally.

***House Wren** (*Troglodytes aedon*). This common and familiar species comes to us about May 1 and remains until October.

***Winter Wren** (*Olbiorchilus hiemalis*). Just before the House Wren leaves us, or about October 1, the Winter Wren comes from the north and is not uncommon until the House Wren returns in May.

Short-billed Marsh Wren (*Cistothorus stellaris*). This species is here a common summer resident of very local distribution.

FIG. 35. WINTER WREN.

Long-billed Marsh Wren (*Telmatodytes palustris*). This abundant inhabitant of our reedy marshes arrives in May and remains until October or November.

FAMILY CERTHIIDÆ. CREEPERS.

***Brown Creeper** (*Certhia familiaris americana*). The Creeper is here a rather common winter resident, arriving from the north about October 1 and remaining until April.

FAMILY SITTIDÆ. NUTHATCHES.

***White-breasted Nuthatch** (*Sitta carolinensis*). A common permanent resident.

***Red-breasted Nuthatch** (*Sitta canadensis*). This bird is sometimes common from the later part of August to October and occasionally remains during the winter.

FIG. 36. RED-BREASTED NUTHATCH.

FAMILY PARIDÆ. TITMICE.

Tufted Titmouse (*Bæolophus bicolor*). This bird is resident and breeds as far north as Orange, N. J. (Riker), and Staten Island, N. Y. (Hollick). Beyond these points it occurs regularly but rarely. It is observed yearly in April at Englewood, N. J. (Chapman). There are few records for Connecticut, and although Giraud leads us to believe it was not uncommon and bred on Long Island when he wrote, it is now very rare there. (Braislin, Auk, XIX, p. 148.)

FIG. 37. CHICKADEE.

***Chickadee** (*Penthestes atricapillus*). The Chickadee is here a common permanent resident, but is more numerous during its migration in October than at other times.

Carolina Chickadee (*Penthestes carolinensis*). "Southeastern United States, north to New Jersey and Illinois." This species reaches the southern limit of our district at Princeton, N. J., where it is a not uncommon resident, while *P. atricapillus* is found there only in the winter (Babson).

FAMILY SYLVIIDÆ. KINGLETS AND GNATCATCHERS.

***Golden-crowned Kinglet** (*Regulus satrapa*). A not common winter resident in favorable localities; it arrives from the north about October 1 and remains until May.

FIG. 38. GOLDEN-CROWNED KINGLET.

***Ruby-crowned Kinglet** (*Regulus calendula*). A common spring, and an abundant fall migrant, arriving from the south about the middle of April and returning late in September.

***Blue-gray Gnatcatcher** (*Polioptila cærulea*). Eastern United States, breeding from the Gulf States to northern Illinois, southern Ontario and northern New Jersey, and wandering rarely to Minnesota and Maine, winters from Florida southward. There are numerous records of capture of this southern species in the vicinity of New York City, but it is not known to occur regularly nearer than Princeton, N. J., where it arrives from "April 25 to May 1" (Scott, The Country, I. 1878, p. 354).

Townsend's Solitaire (*Myadestes townsendi*). A male of this species was taken at King's Park, L. I., November 25, 1905, by J. A. Weber (Dwight, Auk, XXIII, 1906, p. 105).

***Wood Thrush** (*Hylocichla mustelina*). The Wood Thrush is an abundant summer resident, arriving about May 1 and remaining until early October. It

may rightly claim to rank as the most gifted of our summer songsters. (See group, second floor.)

Wilson's Thrush (*Hylocichla fuscescens*). Wilson's Thrush, or the Veery, as it is better called, is a common summer resident, arriving about May 1 and remaining until September. (See group, third floor.)

Gray-cheeked Thrush (*Hylocichla aliciæ*). A common migrant, passing northward in May and southward in September and October.

Bicknell's Thrush (*Hylocichla bicknelli*). So far as records go, this is a rather rare migrant, occurring in May and September and October, but careful search will doubtless show it to be more common than is generally supposed.

Olive-backed Thrush (*Hylocichla ustulata swainsoni*). The Olive-backed Thrush is a common migrant in this vicinity. It passes northward in May and southward in September and October.

Hermit Thrush (*Hylocichla guttata pallasi.*) An abundant migrant and occasionally is found in small numbers during the winter. In the spring it passes northward between April 10 and May 1; its fall migration takes place between October 1 and November 1. There is a record of its probable breeding at Lake Ronkonkoma, L. I. (Dutcher, Auk, III, 1886, p. 443).

American Robin (*Merula migratoria*). The Robin is our most abundant summer resident, and in favorable localities a few may be found in the winter Migrants begin to arrive toward the last of February, and the species is abundant until December. (See group, third floor.)

Varied Thrush (*Ixoreus nævius subsp. ?*). The local status of this Pacific coast bird appears to be well stated in Coues' "Birds of the Colorado Valley," where George N. Lawrence is quoted as follows:

"Besides Cabot's New Jersey example, two others have been procured near New York City—one at Islip, Long Island, shot in the fall, in company with Robins, and now in the possession of the person who secured it, the other at Hoboken, New Jersey. Both were received in the flesh by Mr. J. Akhurst, to be mounted; the Hoboken one was subsequently destroyed by fire in the taxidermist's workshop. All the specimen's in my own cabinet came from the Pacific side."

The Cabot specimen mentioned above by Lawrence is possibly the one referred to by Turnbull (Birds of East. Penn. and N. J.), but without data.

Wheatear (*Saxicola œnanthe leucorhoa*). This northern species is of accidental occurrence in this vicinity; it has been twice recorded from Long Island (Lawrence, Ann. Lyc. Nat. Hist., VIII, 1886, p. 282; Dutcher, Auk, X, 1893, p. 277.)

Bluebird (*Sialia sialis*). The Bluebird is here a common summer resident, an abundant migrant, and not infrequent winter resident. Migrants begin to arrive from the south early in March.

THE AMERICAN ROBIN
Group, Hall No. 308

LIST OF PRINCIPAL PAPERS RELATING TO THE BIRDS OF THE VICINITY OF NEW YORK CITY.

1844. DE KAY, J. E. Zoology of New York, or the New York Fauna; comprising detailed descriptions of all the animals hitherto observed within the State of New York, with brief notices of those occasionally found near its borders, and accompanied by appropriate illustrations. Part II, Birds. Albany: 1 Vol., 4 to, pp. xii, 380, pll. col'd, 141.

Treats of 308 species. "Though still constantly quoted—and properly to be referred to—it has ceased to be regarded as an authority" (Coues).

1844. GIRAUD, J. P., JR. The Birds of Long Island....New York: published by Wiley & Putnam, 161 Broadway....1 Vol., 8vo., pp. i—xxiv, 1—397.

Treats of 286 species, giving descriptions and extended annotations. Only 200 copies of this work are supposed to have been placed in circulation.

1866. LAWRENCE, G. N. Catalogue of Birds observed on New York, Long, and Staten Island and the adjacent parts of New Jersey. Ann. Lyc. Nat. Hist., New York, VIII, pp. 279—300.

A partly annotated list of 327 species.

1868. ABBOTT, C. C. Catalogue of Vertebrate Animals of New Jersey. Cooke's Geology of New Jersey. Appendix E. Birds, pp. 761—798.

An annotated list of 301 species, abounding in errors and only to be used with discrimination.

1869. TURNBULL, W. P. The Birds of East Pennsylvania and New Jersey. Glasgow, Printed for Private Circulation.

1876. BICKNELL, E. P. Field Notes at Riverdale. Forest and Stream, VI, p. 233; also pp. 133, 148, 386, 402.

Winter and spring notes on numerous species.

1876. STEVENS, W. G. Bird arrivals on the Harlem. Forest and Stream, VI, p. 215.

Notes on 40 species.

1877. MERRIAM, C. HART. A Review of the Birds of Connecticut with Remarks on Their Habits. Trans. Conn. Acad., IV, pp. 1—165.

A fully annotated list of 292 species.

1877. STEVENS, W. B. [Arrivals of Birds at West Farms, N. Y., during the springs of 1874, 1875, and 1876.] Forest and Stream, VIII, p. 400.

Dates of arrival of 32 species.

1878. BENNER, F. Bird Notes from Long Island. Forest and Stream, X, pp. 174, 215.

Notes from Astoria on a number of species.

1878. Bicknell, E. P. Evidences of the Carolinian Fauna in the Lower Hudson Valley, Principally from Observations taken at Riverdale, N. Y. Bull. Nutt. Orn. Club, III, pp. 128—132.

On 13 Carolinian species. (See also Allen, J. A. *ibid.*, pp. 149, 150.)

1878. Huyler, A. I. Winter Birds on the Hackensack. The Country, I, p. 149.

1878. Lawrence, N. T. Notes on several rare Birds taken on Long Island. Forest and Stream, X, p. 235.

Notes on 24 species.

1878. Winkle, N. [Spring Birds at Summit, N. J.] The Country, II, p. 57.

1879. Coues, G. H. List of Birds observed in the Naval Hospital Grounds, in Brooklyn City. Bull. Nutt. Orn. Club, IV, pp. 31—33.

Brief notes on 60 species.

1879. Herrick, H. Notes on some Birds of Chatham, N. J. Forest and Stream, XII, p. 165.

1879—80. Mearns, E. A. A list of the Birds of the Hudson Highlands. Bull, Essex (Mass.) Inst., X, pp. 166—179; XI, 43—52, 154—168, 189—204; XII, 11—25, 109—128; XIII, 75—93.

One of the best and most complete of our local papers, treating fully of 209 species. (See also an Addendum adding 5 species in The Auk, VII, 1890, pp. 55, 56; also reviews in Bull. Nutt. Orn. Club, V, 1880, p. 175; VI, 1881, p. 172.)

1879. Nichols, G. N. Migration of some Warblers through Summit, N. J., during the last spring. Forest and Stream, XII, p. 464.

Notes on 18 species.

1879. Roosevelt, T. Notes on some of the Birds of Oyster Bay, Long Island. One-page leaflet, published by the author.

Notes on 17 species.

1879. Scott, W. E. D. Late Fall and Winter Notes on some Birds Observed in the Vicinity of Princeton, N. J., 1878—79. Bull. Nutt. Orn. Club, IV, pp. 81—85.

Notes on 35 species.

1879—85. Fisher, A. K. Occurrence of Several rare Birds near Sing Sing, N. Y. Bull. Nutt. Orn. Club, IV. pp. 61, 62.

Notes on 5 species. For additional notes by the same author on the rarer birds of Sing Sing, see *ibid.*, III, 1878, pp. 191, 192; IV, 1879, p. 234; VI, 1881, p. 245; VII, 1882, pp. 249, 251; VIII, 1883, pp. 121, 180; Auk, II, 1885, pp. 306, 378.

1880. Lawrence, R. Notes on some of the Rarer Birds of Long Island, N. Y. Bull. Nutt. Orn. Club, V, pp. 116, 117.

Notes on 8 species.

1880. Stearns, W. A. List of Birds of Fishkill-on-Hudson, N. Y. 8vo., pp. 16. Published by the author.

A briefly annotated list of 138 species. (Review in Bull. Nutt, Orn. Club, V, 1880, p. 233.)

1881. BERIER, DE L. Notes on a few Birds Observed at Fort Hamilton, Long Island, N. Y. Bull. Nutt. Orn. Club, VI, pp. 11—13.

Brief notes on 10 species.

1881. BERIER, DE L. Notes on Birds Rare or Accidental on Long Island, N. Y. Bull. Nutt. Orn. Club, VI, pp. 125, 126.

Notes on 11 species.

1882. TOWNSEND, A. L. [Arrival of Birds in spring at Bay Ridge, L. I.] Forest and Stream, XVIII, pp. 305, 346, see also p. 427.

Notes on some 30 species.

1884. BARREL, H. F. Arrivals of Birds in [New Providence], N. J., in 1883. Orn. and Oöl, IX, p. 45.

A chronological list of 73 species.

1884. DUTCHER, W. Bird Notes from Long Island, N. Y. Auk, I, pp. 174—179.

On birds striking the Fire Island and Shinnecock Bay Lighthouses.

1884—5. BICKNELL, E. P. A Study of the Singing of our Birds. Auk, I, pp. 60—71, 126—140, 209—218, 322—332; II, 1885, pp. 144—154, 249—262.

On the song-seasons of about 100 species from observations made principally at Riverdale, N. Y.

1884—89. DUTCHER, W. Bird Notes from Long Island. Auk, I, pp. 31—35; II, 1885, pp. 36—39; III, 1886, pp. 432—444; V, 1888, pp. 169—183; VI, 1889, pp. 131—139; X, 1893, pp. 265, 266.

A series of papers on the rarer birds of Long Island, treating of, in all, 71 species.

1885. BARRELL, H. F. Birds of the Upper Passaic Valley, New Jersey. Orn. and Oöl., X, pp. 21—23, 42, 43.

A briefly annotated list of 149 species.

1885. HOLLICK, A. Preliminary List of the Birds known to breed on Staten Island. Proc. Nat. Sci. Assoc., Staten Island. Extra No. 4, December.

A nominal list of 67 species.

1885. LAWRENCE, N. T. Long Island, N. Y., Bird Notes. Auk, II, pp. 272—274.

Notes on 18 species.

1886. PAINE, A. G., JR. Dates of the Arrival of Migratory Birds in the spring of 1886, Central Park, New York City. Orn. and Oöl, XI, pp. 109, 125.

A chronological list of 64 species.

1886. WOODRUFF, L. B. AND PAINE, A. G., JR. Birds of Central Park, New York [City]. A preliminary List. Forest and Stream, XXVI, pp. 386, 387; see also p. 487.

A briefly annotated list of 121 species.

1887. THURBER, E. C. A List of Birds of Morris County, New Jersey. True Democratic Banner (newspaper), Morristown, N. J., Nov. 10, 17, 24.

An annotated list of 205 species. (Review in Auk, V, 1888, pp. 421, 422.)

1888. HALES, H. Bird Notes of Northern New Jersey. Orn. and Oöl., XIII, p. 158.

Notes on the spring migrations at Ridgewood, N. J.

1889. CHAPMAN, F. M. Notes on Birds Observed in the Vicinity of Englewood, N. J. Auk, VI, pp. 302—305.

Notes on 19 species.

1889. CHAPMAN, F. M. Notes on the Mniotiltidæ of Englewood, N. J., Abst. Proc. Linnæan Society [No. 1], for the official year 1888—89, p. 3. (See also Auk, VI, 1889, p. 198.)

A synopsis mentioning 8 species.

1889. CHAPMAN, F. M. Remarks on the Northern Limit of the Carolinian Fauna on the Atlantic Coast. Abst. Proc. Linnæan Society [No. 1], for the official year 1888—89, p. 4. (See also Auk, VI, 1888, p. 199.)

1889. DUTCHER, W. Long Island Birds. Forest and Stream, XXX, p. 444.

A call for information on the occurrence of 52 species.

1889. FOSTER, L. S. Some Nyack Birds. Nyack Evening Journal, Aug. 19.

1889. LAWRENCE, G. N. An account of the Former Abundance of some species of Birds on New York Island, at the time of their Migration to the South. Abst. Proc. Linnæan Society [No. 1], for the official year 1888—89, pp. 6—8. (See also Auk, VI, 1889, pp. 201—204.)

Notes on 13 species, from 1820 to 1850.

1890. NELSON, J. Descriptive Catalogue of the Vertebrates of New Jersey. Geological Survey of New Jersey. Final Report of the State Geologist. Vol. II, Part II. Birds, pp. 518—636.

Based on Abbott's list of 1868 and containing numerous additional errors.

1892. AVERILL, C. K., JR. List of Birds found in the Vicinity of Bridgeport, Connecticut. Prepared for the Bridgeport Scientific Society. Bridgeport, Conn.: Buckingham & Brewer, Printers. 8vo., pp. 1—19.

A briefly annotated list of 246 species. (See review in Auk, X, 1893, p. 352.)

1892. CHAPMAN, F. M. [Birds of Central Park, New York City.] New York Evening Post, Supplement, June 18, 25, July 2, Oct. 15, Dec. 31.

Popular account of some species.

1892. HOWELL, A. H. Brief notes from Long Island. Auk, IX, pp. 306, 307.

Notes on 5 species.

1893. DUTCHER, W. Notes on some Rare Birds in the Collection of the Long Island Historical Society. Auk, X, pp. 267—277.

Notes on 44 species.

1893. EAMES, E. H. Notes from Connecticut. Auk, X, pp. 89, 90, 209.

Notes from Bridgeport on 11 species.

1893. FOSTER, L. S. The Winter Birds of the Vicinity of New York City. Abst. Proc. Linnæan Society, No. 5, pp. 1—3.

A synopsis mentioning 14 of a list of 127 species.

1893. HOWELL, A. H. On the Occurrence of three Rare Birds on Long Island, New York. Auk, X, 1893, pp. 90, 91.

Barn Owl, Orange-crowned Warbler and Bicknell's Thrush.

1894. CHAPMAN, F. M. The Nocturnal Migration of Birds. Popular Science Monthly, XLV, pp. 506—511.

Contains an account of observations made at the Statue of Liberty, Bedloe's Island.

1894. STONE, WITMER. The Birds of Eastern Pennsylvania and New Jersey, With Introductory Chapters on Geographical Distribution and Migration; prepared under the direction of the Delaware Valley Ornithological Club.

A complete and fully annotated list of 352 species. Contains also a Bibliography of the Birds of Pennsylvania and New Jersey.

1894. HOWELL, A. H. Notes on Some Long Island Birds. Auk, XI, pp. 82—84.

Notes on 5 species.

1895. CHAPMAN, FRANK M. Handbook of Birds of Eastern North America. New York, D. Appleton and Co.

Contains tables giving dates of migration at Englewood, N. J., by F. M. Chapman, and one giving dates at which birds begin to nest in the vicinity of New York City. Also notes under each species showing its status at Sing Sing, N. Y., and on Long Island, by A. K. Fisher and Wm. Dutcher, respectively, constituting complete lists for these localities.

1896. BRAISLIN, W. C. Notes on Long Island Birds. Auk, XIII, pp. 87, 88.

Notes on 5 species.

1899. BRAISLIN, W. C. Notes on Long Island Birds. Auk, XVI, pp. 190—193.

Notes on 10 species.

1900. BRAISLIN, W. C. Notes on Birds of Long Island. Auk, XVII, pp. 69—71.

Notes on 6 species.

1901. BABSON, WM. A. Birds of Princeton, New Jersey, and Vicinity. Bulletin of The Bird Club of Princeton University, Vol. I, September, 1901, No. 1. Published by the Club.

A fully annotated list of 231 species.

1902. BRAISLIN, W. C. Notes concerning certain Birds of Long Island. Auk, XIX, pp. 145—149.

Notes on 12 species.

1902. CHERRIE, GEO. K. Bird Notes from Long Island, New York. Auk, XIX, p. 210.

Notes on 4 species.

1902. STONE, WITMER. Report on the Spring Migration of 1902 in eastern Pennsylvania and New Jersey. Cassinia, 1902, pp. 32—48.

Contains notes on various species at Paterson, N. J. (J. H. Clark) and Plainfield, N. J. (W. De W. Miller).

1904. STONE, WITMER. Report on the Spring Migration of 1904 in eastern Pennsylvania and New Jersey. Cassinia, 1904, pp. 46—61.

Contains notes on occurrence of various species at Summit, N. J., by La Rue K. Holmes.

1904. CHAPMAN, FRANK M. Birds' Nests and Eggs, With an Annotated List of the Birds Known to Breed Within Fifty Miles of New York City. A Guide Leaflet to the Collection in the American Museum of Natural History. Guide Leaflet No. 14. Supplement to the American Museum Journal. Vol. IV, No. 2, April, 1904. New York: Published by the Museum. Illustrated.

Includes descriptions of nesting site, and number and color of eggs.

1904. BRAISLIN, W. C. Notes concerning certain Birds of Long Island, N. Y. Auk, XXI, pp. 287—289.

Notes on 9 species.

1905. BRAISLIN, W. C. Notes concerning certain Birds of Long Island, N. Y. Auk, XXI, pp. 167—169.

Notes on 15 species.

1905. STONE, WITMER. Report on the Spring Migration of 1905 in eastern Pennsylvania and New Jersey. Cassinia, 1905, pp. 53—67

Contains notes on occurrence of species at Summit, N. J., by La Rue K. Holmes.

1905. HANN, H. H. A Preliminary List of the Birds of Summit, New Jersey. The Wilson Bulletin, Vol. XVII, No. 4, December, pp. 117—122.

Records 149 species. Briefly annotated.

1905. HOLMES, LA RUE K. Summer Birds of Summit (Union County), New Jersey, and Vicinity. Wilson Bulletin, XVII, No. 1, March, pp. 8—12.

An annotated list of 89 species.

1905. HIX, GEO. E. A Year With the Birds in New York City. The Wilson Bulletin, Vol. XVII, No. 2, June, pp. 35—43.

Records 161 species. Annotated.

1906. BOWDISH, B. S. Some Breeding Warblers of Demarest, N. J. Auk, XXIII, pp. 16—19.

Notes on breeding of eleven species.

ADVANCE TROOP OF THE TJADER EXPEDITION CROSSING THE ATHI RIVER

The American Museum Journal

Vol. vi. OCTOBER, 1906. No. 4

BRIEF REPORTS FROM RETURNED EXPEDITIONS.

I.—THE EXPEDITION TO COLORADO FOR FOSSIL INSECTS.

THERE are three localities famous among paleontologists for the great number of tertiary fossil insects they have yielded: Œningen in Bavaria, Radoboj in Croatia, and Florissant in Colorado. Although the specimens found in the European localities are, as a rule, somewhat better preserved, the number and variety of those found at Florissant are much greater. Thus Scudder, our leading authority on fossil insects, found in the latter locality "in a single summer more than double the number of specimens which the famous localities at Œningen in Bavaria furnished Heer in thirty years." Moreover, the quarries at Florissant are "fifty times as extensive and far more easily worked." Besides an enormous number of plant remains, such as leaves, seeds, twigs, flowers, buds, etc., remains of molluscs, spiders, fishes and birds have also been taken in this locality. The vast collections made by Scudder were described in a series of important papers and monographs beginning in 1876 and terminating in 1900, when a serious illness overtook the talented entomologist and prevented him from continuing his monumental work. Much undescribed material still remains in our large museums.

The credit for having revived an interest in Florissant is due to Judge Junius Henderson and Professor T. D. A. Cockerell, both of the University of Colorado. The former gentleman organized an expedition to Florissant during the summer of 1905 and secured large and valuable collections for the University Museum. Professor T. D. A. and Mrs. W. P. Cockerell maintained a temporary laboratory at Florissant during the past

June and July and kindly invited the author to coöperate with them in securing a collection for the American Museum and in distributing the material to specialists for study and publication in the "Museum Bulletin." The summer's work was successful beyond expectation. Upwards of 2,000 specimens were secured, largely with the assistance of Mrs. W. P. Cockerell and Mr. Sievert A. Rohwer, who were indefatigable in carrying on the

VIEW OF THE ANCIENT MIOCENE LAKE-BED AT FLORISSANT, COLORADO, LOOKING NORTH

work of excavating and preserving the often very fragile plant and insect remains. Professor Cockerell has undertaken to study the plants, of which some 50 new species were found, and the author will describe the ants, which comprise some 800 specimens. Although these are the most abundant of all insects at Florissant they have never been studied. Mr. A. L. Melander has promised to describe the flies (Diptera), and Mr. C. T. Brues the smaller Hymenopterous insects. It is hoped that Mr. C. Schaeffer of

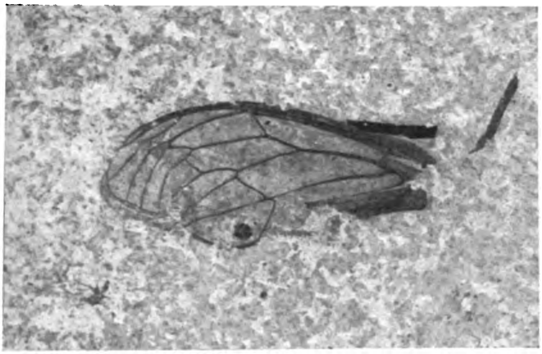
the Brooklyn Institute may be willing to undertake a study of the beetles (Coleoptera), of which a fine series was secured.

The fossiliferous formations at Florissant are shales forming the bed of a shallow lake of unknown age, but probably Miocene, and long since drained by upheaval and distortion. The climate of the region about Florissant at that remote period, to judge from the character of the fossils, was similar to that of the Gulf

FOSSIL STUMP OF SEQUOIA TREE NEAR FLORISSANT, COLORADO

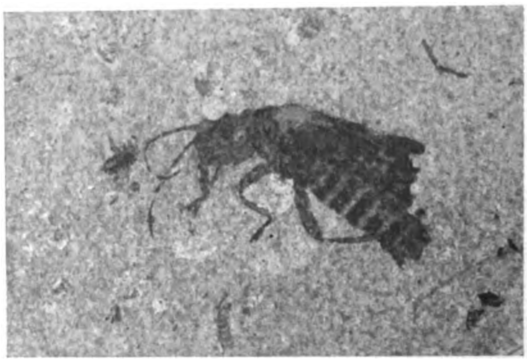
States at the present time. There was a rank growth of huge Sequoias, long-leaved cotton-woods, Planera, rushes and ferns around this placid body of water. Some of the fossilized stumps of the Sequoias may still be seen near the point where Scudder made his excavations. Insects swarmed in the vegetation and were carried out into the lake by the wind, rain and small streams, and drowned in great numbers. Their tiny bodies sank to the bottom and were gradually entombed in fine ashes, mud and sand. The ashes were of volcanic origin and must have been

deposited at different times, so that we must assume the presence of intermittent volcanoes somewhere in the neighborhood of the lake. The different strata, which have evidently been produced by the assorting action of the sluggish lake currents, are often as thin as paper and are not equally fossiliferous. In fact, it is often necessary to remove great masses of shale and sandstone before coming on a rich fossiliferous layer, and this, though often traceable for many square feet, may be only a few inches in thickness. The extremely comminuted nature of the sediment is responsible for the beautiful preservation of many of the plants and insects, which, in the completeness of their detail, remind one of lithographs or delicate etchings.



WING OF A FOSSIL CICADA—(*Lithocicada perita* Ckll.)
Direct reproduction from fossil.

The collections secured by Professor Cockerell and the author show that, although more than 600 species of insects and about 150 species of plants have been described from Florissant, the number still to be unearthed must be enormously greater. One may say, in fact, that only the surface of the vast deposits has been scratched. With few exceptions, the Florissant insects hitherto described, though all belonging to extinct species, are nevertheless very similar to those found in subtropical America at the



UNDESCRIBED SPECIES OF FOSSIL BEETLE (*Meloid*)
Direct reproduction from fossil.

present time. This is an extremely interesting and significant fact, since it emphasizes the enormous age and singular morphological stability and persistence of the insect type. As Quinet says, in a passage quoted by Scudder in the introduction to his "Tertiary Insects of North America": "So fragile, so easy to crush, you would readily believe the insect one of the latest beings produced by nature, one of those which has least resisted the action of time: that its type, genera, its forms, must have been ground to powder a thousand times, annihilated by the revolutions of the globe, and perpetually thrown into the crucible. For where is its defense? Of what value its antennæ, its shield, its wings of gauze, against the commotions and the tempests which change the surface of the earth? When the mountains themselves are overthrown and the seas uplifted, when the giants of structure, the mighty quadrupeds, change form and habit under the pressure of circumstances, will the insect withstand them? Is it which will display most character in nature? Yes! The universe flings itself against a gnat. Where will it find refuge? In its diminutiveness, its nothingness."

Planera longifolia, A VERY COMMON LEAF IN THE FLORISSANT SHALES

W. M. WHEELER.

II.—THE EXPEDITION TO TAHITI.

DURING the late winter and early spring of the present year a research expedition to the island of Tahiti was undertaken by the writer under the auspices of the American Museum of Natural History, with funds contributed anonymously for the purposes of the research. The objects in view were three:

(1) the collection of terrestrial pulmonate gasteropods of the genus *Partula* from as wide an area of the island as possible, for the acquisition of data relating to the geographical distribution of the Tahitian species, and relating to the effect of geographical isolation as a factor in specific evolution; (2) the determination of data relating to the inheritance of various specific characters, such as the color and form of the shell, the direction of the shell's twist, etc.; the viviparous habits of these snails render material collected for the first purpose available also for the second; and (3) the study of the habits of these forms so that living specimens could be brought back to New York and established for extended experiments upon the course of inheritance in pure and mixed breeds.

Leaving San Francisco on February 3, Papeete, the main town of the island of Tahiti, was reached on February 15. It was found on arrival that a terrific cyclone and tidal wave had occurred in that region of the South Seas on February 7 and 8, causing great damage everywhere and great loss of life in the low outlying coral atolls. In Tahiti, the coast roads had been badly washed, making travel uncertain, while in the interior damage to the forests had made many regions quite difficult to explore. These conditions naturally interfered somewhat with the collection of material.

Headquarters were established at Papeete, on the northwestern coast of the island, and during the greater part of the stay of six weeks collecting trips were made from that town as a base. Ten days were spent at Papara, on the south side of Tahiti, the seat of ancient tribal government; and here our hosts, Chief Tati Salmon and his family, offered every facility for the furtherance of the purposes of the expedition.

Geologically the Society Islands consist of a series of volcanic peaks, each surrounded by a more or less complete coral-reef, trending from southeast to northwest. Tahiti and its near neighbor Moorea form the extreme southeastern elements of this range. The island of Tahiti is double, consisting of a main peak twenty miles across, rising to a height of 8,000 feet, and a lesser element about eight miles in diameter, these two being joined by an isthmus of low lands. Each of these elements is cut

radially by more or less regular valleys, some of them being more that a half-mile in width at their mouths, where they debouch upon the low coastal plain of alluvial soil upon which grow the palms and fruit trees characteristic of the tropics. Nearly every one of the eighteen districts of the whole island contains at least one large valley, and often many other lesser valleys, through each of which flows a stream that rises in the higher central part of the island, where the precipitation of rain is almost constant throughout the day. Luxuriant vegetation fills the bottom of each well-watered valley, even up to high barometric levels, and it is upon certain of the plants in the higher and moister parts of the valleys that the Partulæ were to be found. And because of the high and barren intervening ridges certain species are absolutely isolated from their neighbors, while in some cases, where the moist zone extends down quite or almost to the alluvial plain, a certain amount of migration from one valley to another is possible. The facts relating to the connection between geographical isolation and specific differentiation are therefore of the greatest interest.

More than thirty collecting trips were made up the valleys, of which twenty-one were explored, over 400 miles being traveled in their course. Of the 120 miles of coastal circumference, over 70 were covered; of the remainder the peninsula, a uniform region, formed the greater part, and the rest, the northeast part of the island, was practically inaccessible without the expenditure of an inordinate amount of time. The material collected consists of more than ten thousand individuals, adults and adolescents, a number that may rise to twenty thousand when the young are dissected out from the adults. The distance from the sea, the barometric level and other data relating to food plant, etc., were determined in all cases. The snails belong to the species *P. hyalina*, an invariable and widely distributed form; *P. nodosa*, from the southern area, where within recent years it has arisen and spread, at the same time undergoing wide variation; *P. filosa* from a single valley on the northwest side; and the several forms, *amabilis*, *sinistrorsa*, *sinistralis*, *lignaria*, *rubescens* and *crassa*, that are by some regarded as varieties of *P. otaheitana*, still another form, while by others they are regarded as distinct species. For our present purposes, it is the

distribution of these forms that is of primary importance, whether or not their interrelationships be closer than in the case of the first mentioned species.

It is intended to make a statistical examination of the material collected, and of the strength of inheritance in the case o color and form characters as determined by the correlation between the adults and their young. A full report must await such an extended study. Of the live snails, of which there are now more than 8,000, it may be said that the adults are now feeding and producing young, in some cases four months since their collection; the adolescents are also feeding and growing, and, if opportunity permits, will serve for the study of inheritance in direct and hybrid lines.

HENRY EDWARD CRAMPTON.

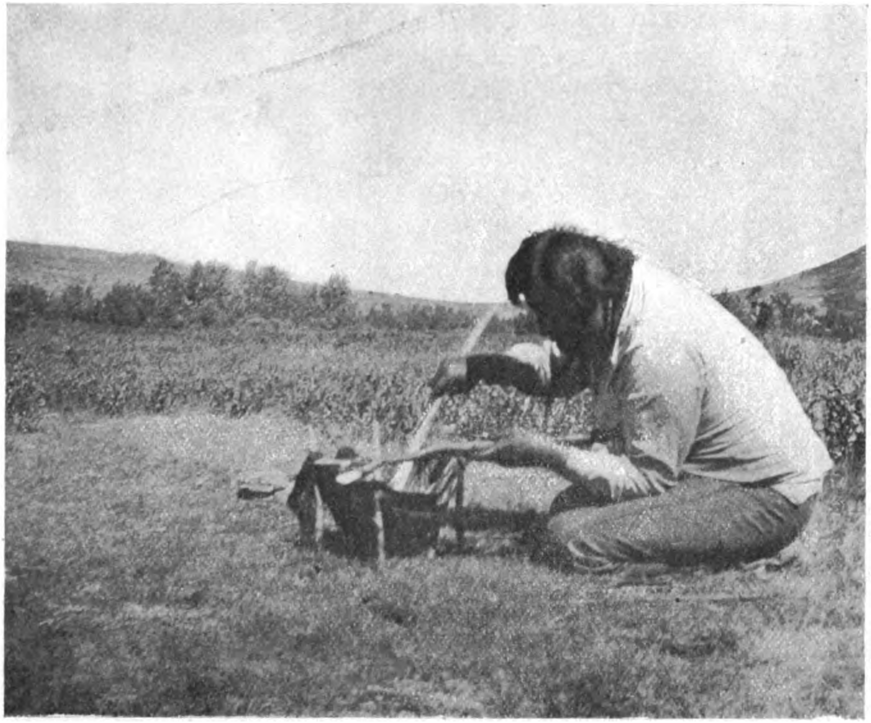
III.—THE EXPEDITION TO THE BLACKFEET INDIAN RESERVATION.

DURING the past summer the writer made another visit to the Blackfeet Indian Reservation in the United States to secure further information as to the ceremonies and industries of this interesting tribe of Plains Indians. The work was quite successful and the Museum has now a large collection with full ethnological notes covering the whole range of their culture.

A number of interesting survivals of ancient industries were observed. In an out-of-the-way camp some women were dressing cow-skins with broken stones instead of the native-made metal tools now in use. For removing the hair a pebble with a broken edge was used, the stone being held in the hand and a glancing blow delivered upon the skin as it lay upon the ground. While this method requires more time than that employing metal tools, it has an advantage in that the danger of cutting into the texture is avoided. In former times the skin was reduced to the required thickness by scrapers flaked from quartzite boulders.

In another camp an old man gave a demonstration of a type of cooking often employed by the buffalo hunting Indians when on the war-path, a method that may at one time have been the usual manner of cooking. At the demonstration witnessed this

summer, a soup known to the Blackfeet as blood-soup, was boiled in the suspended paunch of a beef by dropping heated stones into the mixture. The stones were heated in a fire of twigs and cow chips. They were carried to the paunch by two sticks, one forked and the other straight; the latter being used to stir the soup as it boiled. In former times the boiling was done in the hide of a buffalo, supported in the manner just described



DEMONSTRATION OF COOKING IN A PAUNCH BY MEANS OF HOT STONES. BLACKFEET INDIAN RESERVATION, MONTANA, 1906

or tucked into a hole in the ground. A great deal of information on other phases of native life was obtained, which will enrich the Museum's exhibit of the Plains Indians.

On the top of a large hill the secret fasting-place of a medicine man was discovered. An oval structure of stones had been erected with an opening to the east. The enclosure was lined with an evergreen resembling wild juniper and was barely large

enough to accommodate an average-sized person in a sitting posture. At one side of the shelter were the remains of an offering to the Sun, consisting of clothing and eagle feathers. On such lonely hilltops men often fast and pray for several days and nights seeking a vision or other signs from the supernatural power. The strong belief that the ghosts of the dead frequent the hill-

SECRET FASTING PLACE ON A LONELY HILL. BLACKFEET INDIAN RESERVATION, MONTANA, 1906

tops, and set their marks upon all living persons found there, creates a fear in the mind of the lone faster that can be overcome only by the greatest courage.

Like many other people the Blackfeet speak of the immaterial part of themselves as the shadow. When a man is near death, they say that his shadow is about to depart, etc. After death these shadows are supposed to make frequent visits to their old

haunts and even communicate with the living. The religious ceremonies of the Blackfeet are quite complex and are usually based upon elaborate rituals. These rituals are in turn based upon one or more myths. In some cases it seems possible to trace out the development of a ritual by successive additions from separate myths. It is interesting to note, however, that these myths still remain distinct and independent, while the rituals are justified by reference to them. Several of these rituals have been recorded by phonograph and transcriptions made, which together with the accompanying ceremonial objects and regalia give the Museum a valuable addition to its North American collections.

Another important feature of this visit was the discovery of extensive archæological remains on the site of the present Blackfeet Reservation. Up to this time next to nothing was known of the archæology of the head-waters of the Missouri and the Plains to the north, and some archæologists have ventured to assume that this region was peopled within the last five hundred years. While the mere finding of deeply imbedded remains does not prove ancient occupation, nevertheless, it marks an important advance in our knowledge of this area.

With the result of the season's work the Museum has available the information and material for a critical study of the origin of the Blackfeet tribes and the presentation of their native culture, both material and immaterial. As these people occupied the extreme northwest corner of the Plains and were in geographical proximity to the Indians of British Columbia, especially investigated by the Museum, the recording of their culture is of considerable ethnological importance.

CLARK WISSLER.

IV.—THE EXPEDITION TO THE WEST FOR BIRD GROUPS.

THE writer, accompanied by J. D. Figgins, of the Department of Preparation, and Bruce Horsfall, artist, left New York April 28, 1906, to gather material for groups of certain western birds. These groups belong in the series designed to show not only North American birds, but North America as well.

That is, each group is accompanied by a panoramic background, painted from nature, of the country in which the studies for the group were made.

It is desired in these large paintings to present so wide a variety of types of American scenery that when the undertaking is completed we shall have an adequate representation of American scenery. Such an exhibit will demand attention not only because of its beauty, but also because of its educational value. No one could examine it without receiving more or less definite impressions of the topography of this country, of the appearance of its prairies, plains and mountains, its deserts and marshes.

In selecting subjects for the season's work, therefore, the country as well as its bird-life was taken into consideration. In Nebraska it was proposed to study Prairie Hens and their home; in Wyoming, the Sage Hen of the sage plains, and the Golden Eagle in the clay bluffs; in southern Arizona, the birds of the remarkable cactus-grown deserts; in the Coast Range of southern California, the California Condor, and among the tulé lakes of southeastern Oregon, the White Pelican and other water-birds which nest there in immense numbers.

Thanks to the coöperation of local naturalists and of the various correspondents whose advice had been secured in advance the work of the expedition was performed on schedule time, material for all the contemplated groups being secured.

In Nebraska, through the assistance of Professor Lawrence Bruner of the State University and Mr. Wm. G. Mast of the Forest Service, at Halsey, we lost no time in finding a country where Prairie Hens are still abundant. The birds were indulging in the peculiar antics which mark the advent of their breeding season, and with the aid of a blind the writer succeeded in making a study of their singular evolutions at close range.

At Tucson we received much valuable advice and information from the staff of the Carnegie Desert Laboratory, and have especially to thank Dr. D. T. MacDougal, the Director of the Department of Botanical Research of the Carnegie Institution. Our camp here was most favorably situated for the prosecution of our work, which, it may be added, so far as the vegetation is concerned, is by far the most ambitious of any we have thus far

planned. However, Mr. Figgins already has the accessories for this group so far advanced that its success is assured. The scene selected for the background, showing the Santa Cruz Valley and Santa Catalina Mountains, is one of great beauty, and the group promises to be among the most noteworthy of the series.

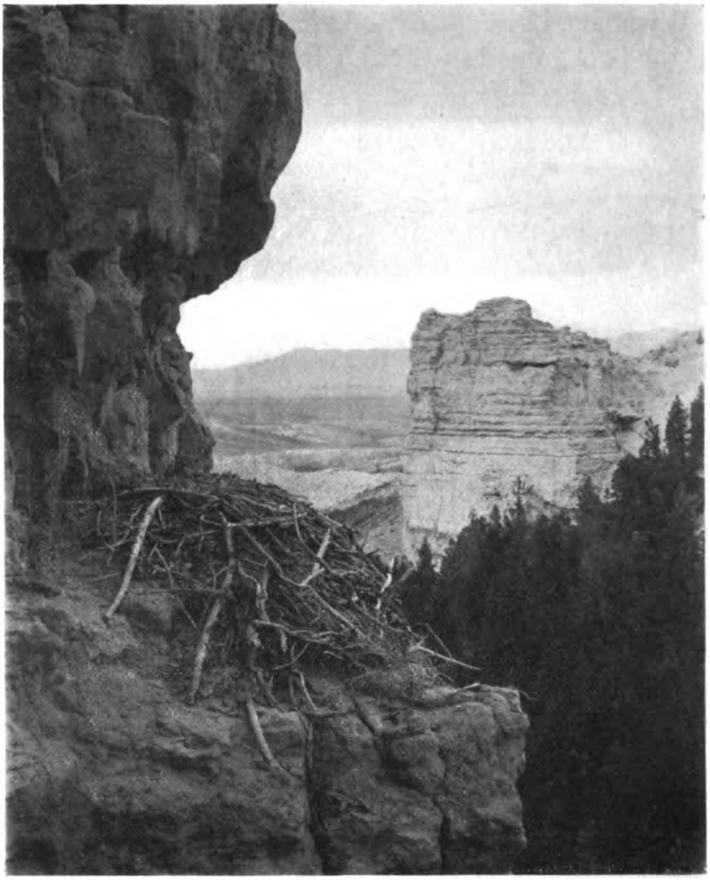
In Wyoming, Mr. C. J. Hittell of San Francisco, whose painting for the background to the San Joaquin Valley group has been

SCENE NEAR TUSCON, ARIZONA; WHERE STUDIES WERE MADE FOR THE DESERT BIRD GRCUP

so much admired, took Mr. Horsfall's place, and, thea ccessory work now being of a comparatively simple nature, Mr. Figgins returned to the Museum. With a "prairie schooner" outfit, we penetrated the Bates' Hole region some fifty miles north of Medicine Bow, encountering snow and cold, wintry weather, strikingly unlike the torrid climate we had left in Arizona. The photograph on page 212, shows the nest and scene selected for the Golden Eagle group. The background for the Sage Hen

group will show the wide-reaching sage plains with the Snowy Range and Elk Mountain on the horizon.

In southern California we were exceptionally fortunate in securing the services of a ranchman who knew of nesting sites of the now rare and retiring California Condor. The nest-site



STUDY FOR GOLDEN EAGLE GROUP, BATES' HOLE, WYOMING

of which studies were made is high in the walls of Piru Cañon, which will appear in the background to the group.

From the rocky aërie of the Condor we went to the totally different home of the White Pelican in the great tulé lakes of Oregon. The Pelicans, with California and Ring-billed Gulls, Caspian Terns, Cormorants and Great Blue Herons, here nest

on the floating tulé islands where they are secure from the attack of predaceous mammals.

The background to this group will show some of the many bird-inhabited islets, while thirty miles away snow-crowned Mt. Shasta rising impressively, dominates the scene.

The Government has selected these lakes for reclamation by drainage. The work is already well advanced, and the birds will soon find that they have failed to secure title to their homes through proper entry at the land office. The nine points of possession will yield to the one of might, and alfalfa will grow where the Pelicans, Gulls and Terns now raise their young. The Museum is fortunate, therefore, in securing material for this group before the demands of civilization shall have forced the birds to abandon the region.

FRANK M. CHAPMAN.

V.—ENTOMOLOGICAL EXPEDITION TO THE BLACK MOUNTAINS OF NORTH CAROLINA.

THE generosity of Mr. Samuel V. Hoffman enabled the Curator of the Department of Entomology to make a visit, lasting from June 20 to October 1, to the Black Mountains in western North Carolina. This trip was in continuation of the work of previous years in the same region through funds provided by the late Very Reverend Eugene A. Hoffman.

The object of this trip was to collect species and data not before obtained. In this respect the expedition was only partly successful owing to the heavy and unusual rain and fog which prevailed throughout the season. Still a large number of exceedingly interesting species and of species new to science were collected, particularly of bees, wasps, flies, beetles, as well as representatives of other orders of insects.

Many new species of insect galls and their makers were bred and four specimens of the beautiful, metallic green long-horn beetle (*Anthophylax hoffmani*), named in honor of the late Very Reverend Eugene A. Hoffman, were taken in the dense balsam forests which cover the summit of the Black Mountains. A figure of this insect was published in the MUSEUM JOURNAL, Vol. IV, page 11. In all, at least 8,000 specimens were collected.

The insect life of the Black Mountains is the most Alpine of the southern Alleghanian fauna and, therefore, most typical of that fauna which skirted the great ice pack of the glacial epochs. The species of this fauna occupied a large part of the area of eastern North America during glacial times, during which most of them became extinct. Therefore, the species of the Appalachian system are a remnant of an at one time very extensive fauna. Their present relationships are, to a certain extent, with the modified forms of lower altitudes in their neighborhood, but, to a far greater extent, with the boreal forms found in more northern latitudes. This boreal fauna is the one from which fully one-half of the present species in this country have been derived. Consequently a proper understanding of the species from these regions gives one a better idea of the origin of all the types having northern affinities.

The Black Mountains being the loftiest of the great Appalachian System (Mt. Mitchell, with an elevation of 6,710 feet, being the highest peak,) were therefore selected as a region in which the remains of this pre-glacial life could be studied to the best advantage.

WILLIAM BEUTENMÜLLER.

THE TJÄDER EAST AFRICA EXPEDITION.

RECENT reports from the Tjäder Expedition, which left New York early in the year for an extended collecting trip in British East Africa, indicate that the party has been remarkably successful in securing fine specimens of large mammals. This expedition was made possible through the generosity of Mr. Samuel Thorne and is conducted by Mr. Richard Tjäder, who is accompanied by Mr. Herbert Lang, one of the Museum's preparators.

The party entered Africa by way of Mombasa and made its first camp in May on the banks of the Athi River. In this region Mr. Tjäder and his assistants secured specimens of zebras, hartbeests, Thompson's gazelle, antelopes and birds. From the Athi River the party marched northward, making its headquarters for three weeks at Kijabe (Jabe Hill). In the hunting

grounds near this place two fine rhinoceroses were taken, the larger measuring 11½ feet in length and 5½ feet in height.

At Maroroni River camp, north of Kijabe, an unusually large elephant was killed. It was 25 feet 9 inches in length and 11 feet 5 inches in height. Its tusks were 6 feet 4 inches long and weighed from 180 to 200 pounds.

During the latter part of July the expedition was encamped on a plateau 5,000 feet high, on the line of the equator, near Mt.

THE FIRST ZEBRAS OF THE TJÄDER EXPEDITION

Kenia. In this region game was abundant, and the skull, skin and skeleton of a fine rhinoceros, a buffalo and three kinds of antelope were secured.

The first week in August the party pushed northward through pathless forests and over a mountainous region, finally pitching camp on the south shore of Lake Harrington. From this camp Mr. Tjäder reports the killing of flamingos, crocodiles, hartbeests and oryx antelopes.

It is the plan of the expedition to push northward as far as Lake Baringo, a distance of between four and five hundred

miles from the coast; then, after swinging southeastward to Laikipia, to return by way of Mt. Kenia to Kijabe, which they expected to reach about September 12. From this point they intend to traverse the practically unknown country southwest of Kijabe toward German East Africa.

MUSEUM LECTURE SCHEDULE.

MEMBERS' COURSE.

The first course of lectures for the season 1906–1907 to members of the American Museum of Natural History and those holding complimentary tickets given them by members will be given according to the following programme. The lectures will be delivered by members of the scientific staff of the Museum and will be fully illustrated by stereopticon:

Nov. 8. Frank M. Chapman,
A Sketch of California Bird-Life.

Nov. 15. Henry E. Crampton,
A Zoölogist's Journey to the Society Islands.

Nov. 22. Louis P. Gratacap,
Iceland—Its Scenery and Inhabitants.

Dec. 6. S. Alfred Mitchell,
Fragments of Other Worlds: An Astronomical Lecture with special reference to the Museum's Collections of Meteorites.

Dec. 13. Edmund Otis Hovey,
Subject announced later.

PEOPLE'S COURSE.

The programme of the Free Lectures to the people which are given Tuesday and Saturday evenings in coöperation with the Department of Education of the City of New York for the first course of the season 1906–1907 is as as follows:

A Course of Eleven Lectures on European Geography.
A Course of Five Lectures on Chemistry.
A Course of Six Lectures on Physical Geography.

Tuesday, October 2d. PROF. LOUIS AUGUSTE LOISEAUX.
1. "A Walking Tour in Switzerland."
Illustrated by stereopticon views.

Saturday, October 6th. PROF. MORRIS LOEB.
(Of New York University).
1. "Introduction to the Study of the Carbohydrates."
The first of a course of five lectures on "The Chemistry of the Carbohydrates."
Illustrated by specimens and chemical experiments.

Tuesday, October 9th. DR. WILLIAM A. MURRILL.
2. "The Austrian Tyrol."
Illustrated by stereopticon views.

Saturday, October 13th. PROF. MORRIS LOEB.
2. "Classification of Carbohydrates. Their Occurrence in Nature. (a) Single Sugars."
Illustrated by specimens and chemical experiments.

Tuesday, October 16th. DR. LEWIS GASTON LEARY.
3. "The Mighty Danube."
Illustrated by stereopticon views.

Saturday, October 20th. PROF. MORRIS LOEB.
3. (b) "Double Sugars."
Illustrated by specimens and chemical experiments.

Tuesday, October 23d. PROF. HENRY E. NORTHROP.
4. "Munich and the Bavarian Alps."
Illustrated by stereopticon views.

Saturday, October 27th. PROF. MORRIS LOEB.
4. "Complex Carbohydrates.—I."
Illustrated by specimens and chemical experiments.

Tuesday, October 30th. PROF. LOUIS AUGUSTE LOISEAUX.
5. "Northern Italy."
Illustrated by stereopticon views.

Saturday, November 3d. PROF. MORRIS LOEB.
5. "Complex Carbohydrates.—II."
Illustrated by specimens and chemical experiments.

Tuesday, November 6th. COL. EDWIN A. HAVERS.
6. "The Mediterranean."
Illustrated by stereopticon views.

Saturday, November 10th. PROF. WILLIAM LIBBEY.
1. "Erosion." The first of a course of six lectures on "Physical Geography."
Illustrated by stereopticon views.

Tuesday, November 13th. Mr. Arthur Stanley Riggs.
7. "Naples, Its Environs and Vesuvius."
Illustrated by stereopticon views.
Saturday, November 17th. Prof. William Libbey.
2. "Rivers."
Illustrated by stereopticon views.
Tuesday, November 20th. Mr. Arthur Stanley Riggs.
8. "Vistas in Sicily."
Illustrated by stereopticon views.
Saturday, November 24th. Prof. William Libbey.
3. "Geysers."
Illustrated by stereopticon views.
Tuesday, November 27th. Mr. Frederick E. Partington.
9. "Greece."
Illustrated by stereopticon views.
Saturday, December 1st. Prof. William Libbey.
4. "Volcanoes."
Illustrated by stereopticon views.
Tuesday, December 4th. Mr. Frederick E. Partington.
10. "Constantinople and the Bosphorus."
Illustrated by stereopticon views.
Saturday, December 8th. Prof. William Libbey.
5. "Earthquakes."
Illustrated by stereopticon views.
Tuesday, December 11th. Mr. Arthur Stanley Riggs.
11. "Egypt and the Nile."
Illustrated by stereopticon views.
Saturday, December 15th. Prof. William Libbey.
6. "Glaciers."
Illustrated by stereopticon views.

A GUIDE TO THE SPONGE ALCOVE IN THE AMERICAN MUSEUM OF NATURAL HISTORY.[1]

By Roy Waldo Miner,

Assistant Curator Department of Invertebrate Zoölogy.

SPONGES are among the most abundant and most widely distributed of sea-animals. With the exception of one family, the fresh-water sponges, they are found in all seas of the globe ranging from shallow waters to beyond a depth of 1,300 feet. The bath-sponges of commerce, with which the word "sponge" is associated in the minds of most people, although from a commercial point of view the most important of the group, form but a single family, *i. e.*, the Spongidæ. The rest of the subkingdom with its great multiplicity of forms is doubtless comparatively unknown to the average person. Even the commercial sponge as it reaches us gives but little idea of what a sponge really is, as it is only the supporting or skeletal part of the animal colony denuded of its fleshy coat of living tissue.

The living sponge is either a single animal or a colony of animals. It is always sessile, that is, attached to the sea bottom, and incapable of locomotion. For this reason it has often been regarded as a plant. But since, in more recent years, its life processes and larval history have become better known, especially since it has come under the eye of the compound microscope, its animal nature has become clearly established.

Sponges show all variations of form, size, and color. There are cake-like sponges, dome-shaped sponges, and fan-shaped sponges. Some are branched like trees; in others the branches reunite to form a complicated network. Some are shaped like huge cups or goblets; some gather in clusters of trumpet- and

[1] Issued also in separate form as Guide Leaflet No 23.

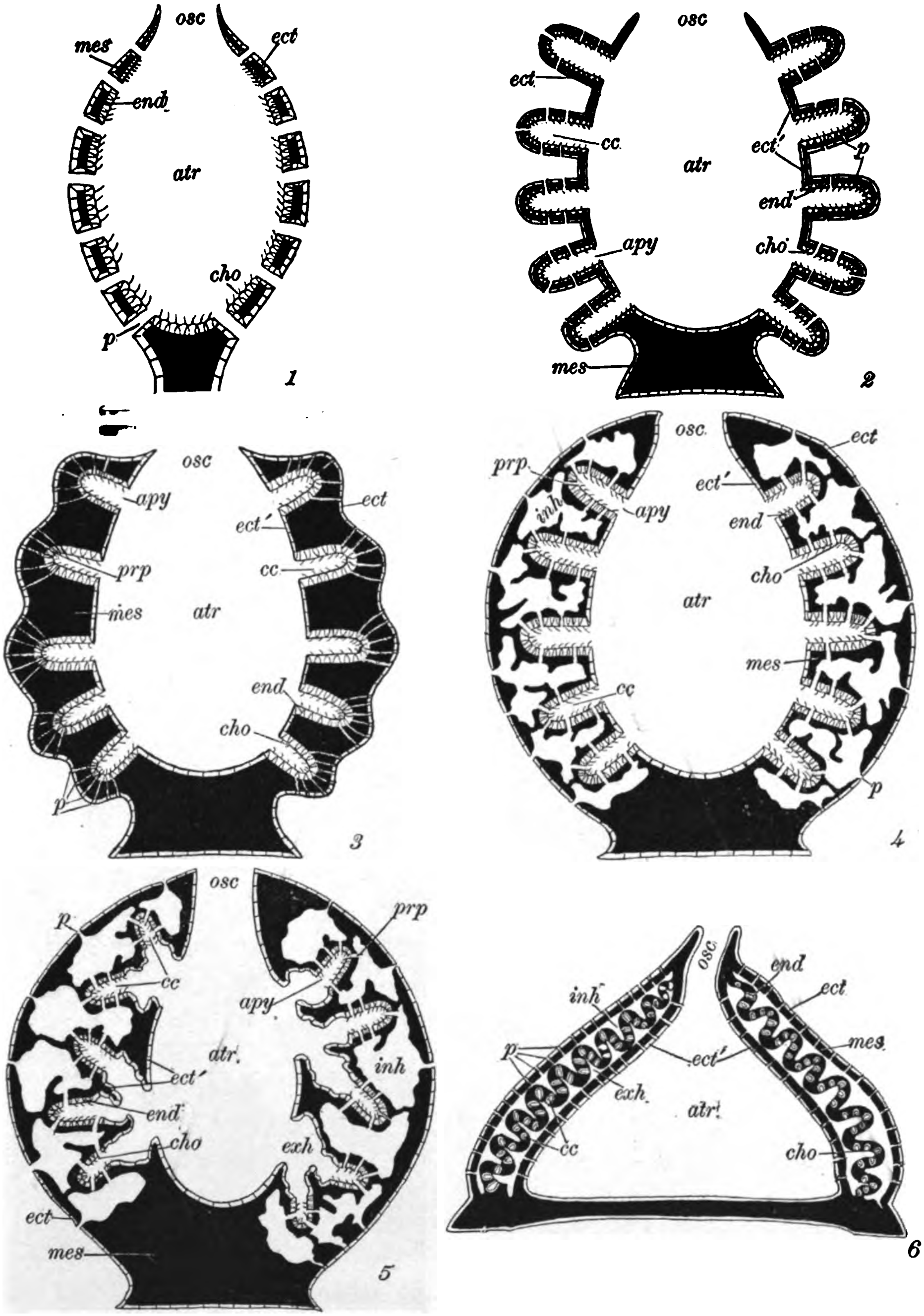
tube-like forms, and even the simplest and most primitive sponges are often shaped like graceful vases. All these forms are found in sizes varying from that of a pinhead to the height of a man.

Their color is as varied as their shape and size. They run through the whole chromatic scale from brilliant red, yellow, and green to the most delicate blue and the deepest violet, in every gradation of shade and tint. Some are pure white, others are shining black, while still others reflect from their opal spicules all the colors of the rainbow.

As the form and color of sponges, however, may vary as much among members of the same species as among those of different species these factors cannot be depended on for classification. The same sponge which in deep water shows the branching habit, in shallower water appears as a flat encrusting colony; or a sponge which has a symmetrical vase-like form, many feet below the surface of the sea, where it is little disturbed by outer influences, may be of the same species as an irregular one-sided mass growing in shallow water or in the crevice of a rock. Again a sponge usually dome-shaped may send out a finger-like process from its upper surface which becomes branched and unites with the branches of other finger-like processes. In other words external form in sponges is not a constant or essential factor. It is purely a matter of environment, in which gravity plays an important part. This tendency to vary has made the arrangement of sponges in an orderly and natural system, a difficult task, much complicated by the fact that for many years classification has been wrongly based upon these very factors. Since, however, the microscope has been developed to its present perfection, it has been found that the arrangement of the skeleton and the form of the spicules or skeletal units, together with the structure of the canal system, furnish more constant data for classification. This can be brought out more clearly in discussing the anatomy of the sponge.

ANATOMY.

In considering the anatomy of sponges it is sufficient for our purpose to concern ourselves with:



FIGS. 1—6.—DIAGRAMS ILLUSTRATING CANAL SYSTEMS IN DIFFERENT TYPES OF SPONGES (after Schulze).

1. Ascon type ; 2–5. Variations of Sycon type ; 6. Rhagon type ; *ect.*, ectoderm of exterior; *ect ′*, ectoderm of atrial cavity ; *mes.*, mesoderm ; *end.*, endoderm ; *osc.*, osculum; *atr.*, atrial cavity or cloaca ; *cho.*, choanocyte layer ; *cc.*, flagellate chambers ; *p.*, pores ; *prp.*, prosopyles ; *apy.*, apopyles ; *inh.*, inhalent cavities; *exh.*, exhalent cavities.

1. General Structure,
2. The Canal Systems,
3. The Skeleton.

1. *General Structure.*

This is best shown by the description of a simple sponge in which the general characteristics of the subkingdom predominate, unmodified by special conditions.

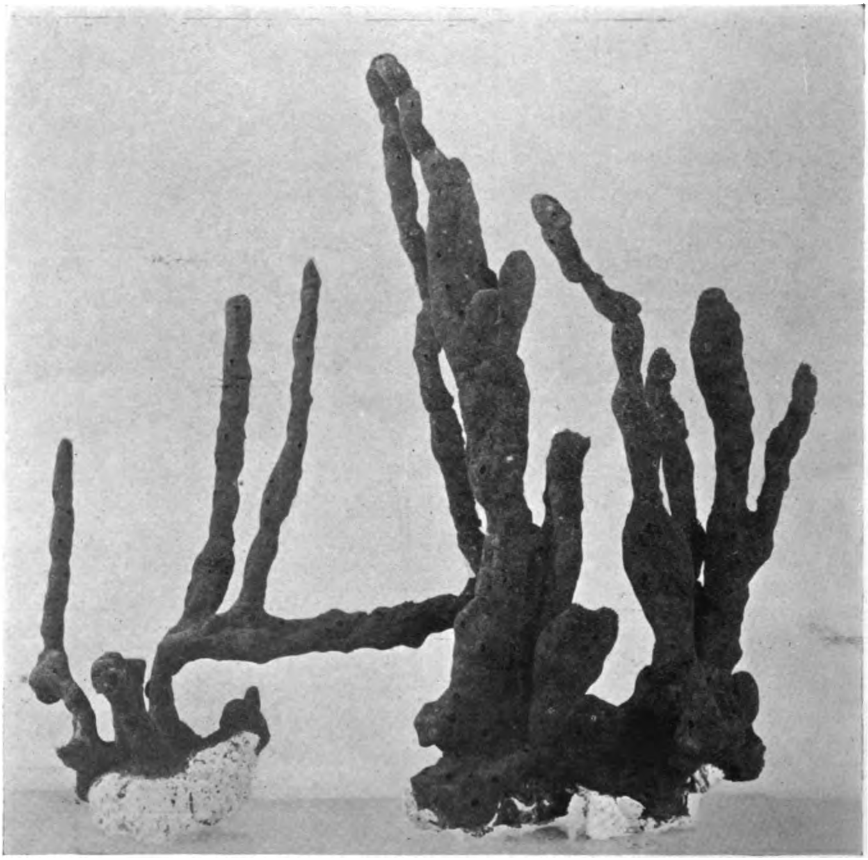


FIG. 7.—AN EXAMPLE OF THE BRANCHING HABIT

The simplest, most primitive, and at the same time most typical sponge is *Ascetta primordialis*, first described by Häckel

(See Fig. 1.). This sponge is typically vase-like in external form. The circular opening at the top of the vase is known as the *osculum* (*osc.*) in spite of the fact that it is excretory and has neither structurally nor functionally the characteristics of a mouth.

The walls of the vase are perforated with numerous regularly arranged openings or pores (*p.*) which open directly into the hollow interior of the sponge—called the *paragastric* or *atrial cavity* (*atr.*). The walls are made up of three layers: 1st, the ectoderm, or outer layer; 2d, the endoderm, or inner layer; 3d, the mesoderm, or middle layer.

The *ectoderm* (*ect.*) is a thin layer of cells, generally arranged in mosaic form and known as "pavement cells." In the case of this species, however, the walls of the cells have disappeared and left the protoplasmic cell-contents continuous over the entire surface of the animal. Such a layer is called a *syncytium.*

The *endoderm* (*end.*) lines the paragastric cavity and is made up of a layer of peculiar and characteristic cells called "collared cells," or *choanocytes* (*cho.*), found nowhere else among many-celled animals. They are so called from a collar-like rim around the outer edge of the cell out of which extends a long whip-like

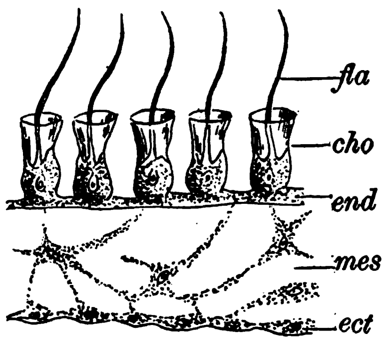


FIG. 8.—SECTION THROUGH SPONGE WALL
ect., ectoderm ; *mes.*, mesoderm ; *end.*, endoderm ; *cho.*, choanocytes or "collared cells"; *fla.*, flagellum.

filament or *flagellum* (*fla.*). The continuous vibration of these flagella produces a current by means of which the sea-water, with its multitude of tiny animal and plant forms, is sucked in through the pores. The organisms are then seized upon by the

choanocytes and their digestible parts absorbed. What is left is discarded and flows with the current out through the osculum at the summit of the vase.

The *mesoderm* (*mes.*) is a thin jelly-like layer between the ectoderm and endoderm. It contains scattered amœboid cells and the reproductive elements, and is the origin of the skeleton.

2. *The Canal Systems.*

In the form of sponge just described the mesoderm is extremely thin, but if, as in the majority of sponges, there is a greater or less thickening of this layer, the pores will no longer be perforations, but will become transformed into tubes or canals

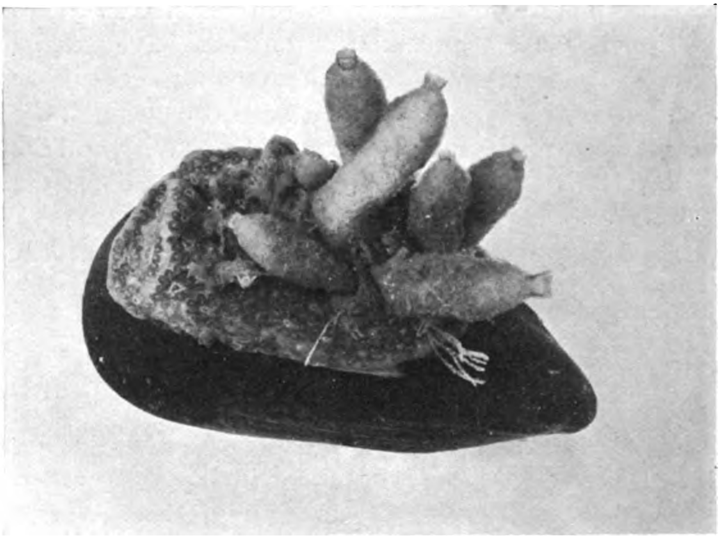


FIG. 9.—A SYCON SPONGE (*Grantia ciliata* Fleming) GROWING ON A MUSSEL SHELL
Star-shaped colonies of the Ascidian *Botryllus* are also growing on the same shell.

(See p. 221, Fig. 3), which may branch and be modified in various ways. This gives rise to three general types of sponges which are therefore based mainly on the arrangement and variations of the pore- and canal-systems. These are known as

(a) The Ascon Type,
(b) The Sycon Type,
(c) The Rhagon Type.

(a) *The Ascon Type* (p. 221, Fig 1.). This type is characterized by sponges having walls with a thin layer of mesodermal tissue (*mes.*), and therefore, with pores (*p.*) opening directly from the outside into the paragastric cavity (*atr.*). The endoderm (*end.*) is always continuously lined with choanocytes or "collared cells" (*cho.*). *Ascetta primordialis*, therefore, is the representative of this group. Another example is *Leucosolenia*, of which a specimen may be seen in this alcove. A complication of this type is shown by *Homoderma*, which differs from *Ascetta* in having its surface broken up by a multitude of radially arranged thimble-like prolongations or diverticula, each with a central cavity of its own, opening into the main paragastric cavity of the sponge and lined with a continuation of the endoderm with its collared cells. In this case the pores are found only in the walls of the diverticula.

(b) *The Sycon Type* (p. 221, Figs. 2–5; p. 224, Fig. 9). In this type, as in the example just described (*Homoderma*), the walls of the paragastric cavity are prolonged into radially arranged branches called *radial tubes* (*cc.*) but the choanocytes, instead of lining both the paragastric cavity and the radial tubes, are found only in the latter, while the former is invested with a layer of epidermal "pavement cells" (*ect.*) like the outside of the sponge. The mouth of the radial tube by which it opens into the central cavity is called the *apopyle* (*apy.*). In the simpler sponges of the Sycon type, such as *Sycon ciliatum*, the pores open directly into the radial tubes (Fig. 2) and the outer surface of the sponge is covered with papillæ corresponding to the cavities within. In these forms, the mesoderm (*mes.*) continues to be thin. In other forms, however, the mesoderm becomes greatly thickened and completely fills the spaces between the radial tubes (Fig. 3) so that the outer surface appears comparatively smooth and free from papillæ. Under these circumstances the pores cannot open directly from the outside into the radial tubes, so they lengthen into *inhalent canals* traversing the mesoderm. In still other forms (Fig. 4) the canals have enlarged to wide cavities or *inhalent lacunæ* (*inh.*) opening to the outside by the pores and into the radial tubes by openings called *prosopyles* (*prp.*). Another complication occurs in the Leucons where the walls of the para-

gastric cavity become folded in such a manner that the radial tubes lose their radial position and open into the folds or their branches (Fig. 5, *cc.*). The openings by which the folds communicate with the paragastric cavity may then become narrowed and thus large irregular spaces called *exhalent lacunæ* (*exh.*) are formed, with the result that the radial tubes become mere tubular chambers (*cc.*) communicating at the open end with the paragastric cavity (*atr.*) only by the intervention of the inhalent lacunæ (*inh.*), which in turn communicate with the outside by the pores. As both the inhalent and exhalent lacunæ are lined

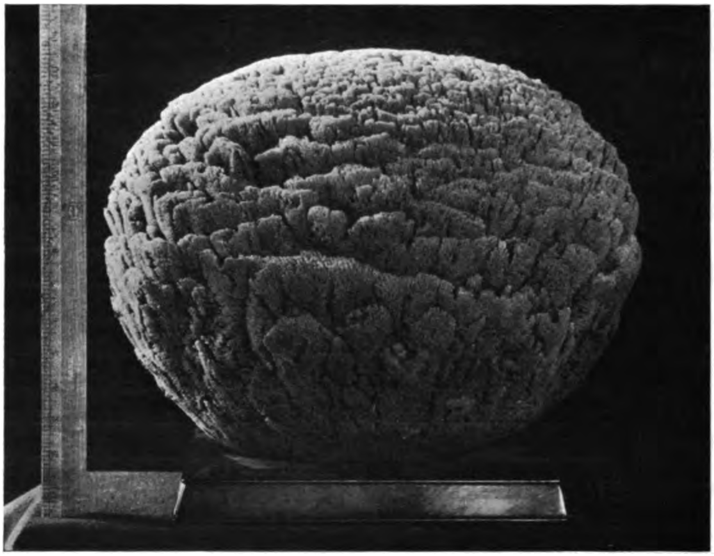


FIG. 10.—A LARGE BAHAMAN SPONGE (*Hippospongia cerebriformis* D. & M.)

with "pavement cells" (*ect.*) the choanocytes become restricted to the tubular *flagellate chambers*, as the radial tubes are now called.

(c) *The Rhagon Type* (p. 221, Fig, 6). The two preceding types of canal arrangement are peculiar to the sponges having a calcareous or carbonate of lime skeleton. The great majority of sponges, including those having "glass" skeletons, horny skeletons or no skeletons at all, belong to the Rhagon type. In this case the flagellate chambers (*cc.*) are very small and numerous and, instead of being tubular, are spherical. The mesoderm varies

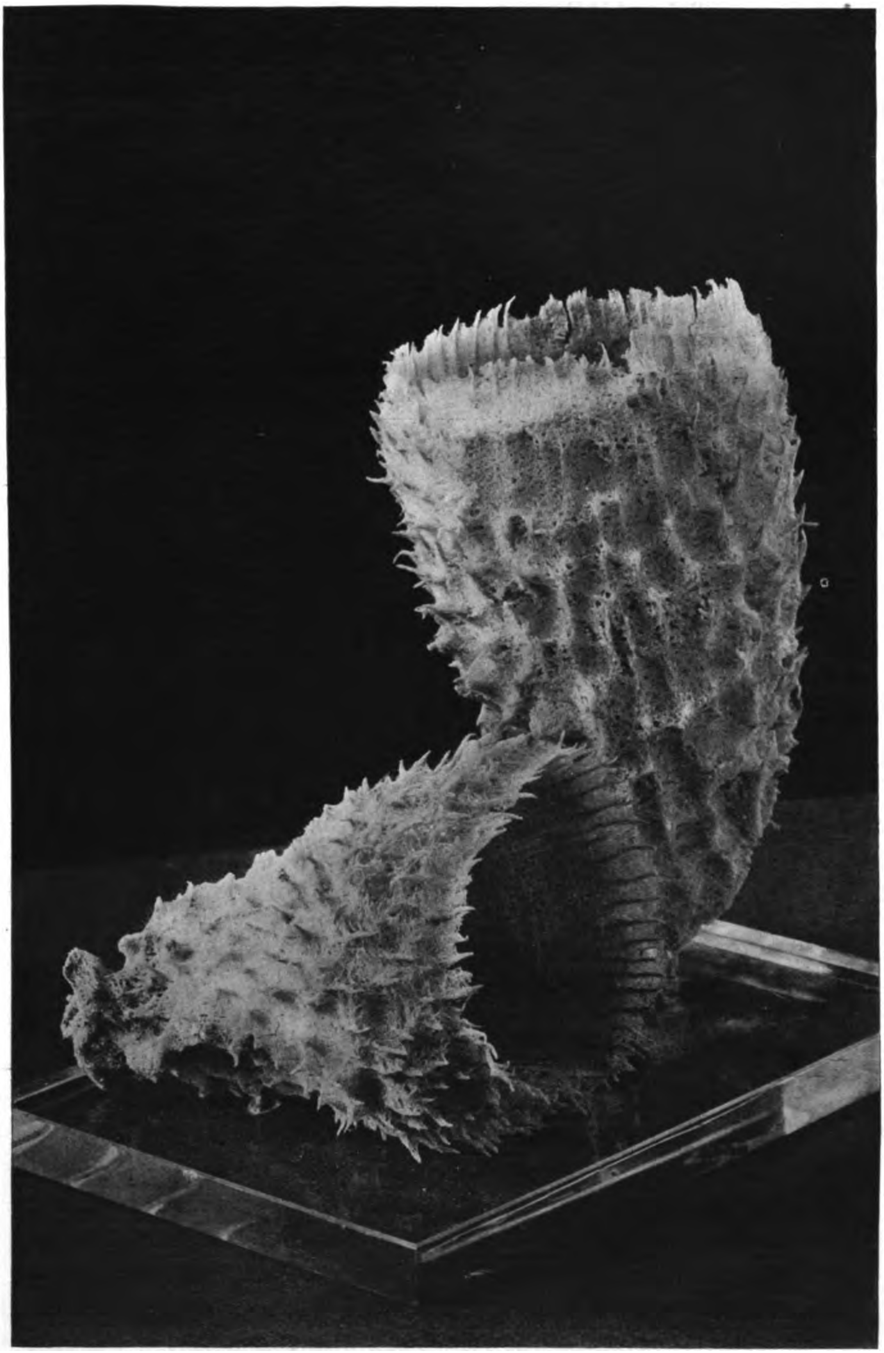


FIG. 11.—NON-COMMERCIAL HORNY SPONGES (*Stelospongia* sp.)
A trumpet-like form showing plainly the *principal fibers* projecting around the rim, and the *oscula* or excurrent openings lining the cavity of the specimen.

greatly in thickness, and the canal system may become much complicated through the folding of the walls of the paragastric cavity and the development of wide mesodermal cavities (*inh.* and *exh.*).

3. *The Skeleton.*

One of the most remarkable features of sponge structure is the skeleton. It is by far the most reliable basis for classifying the sponges yet discovered, inasmuch as it is comparatively unaffected by the external surroundings of the individual and

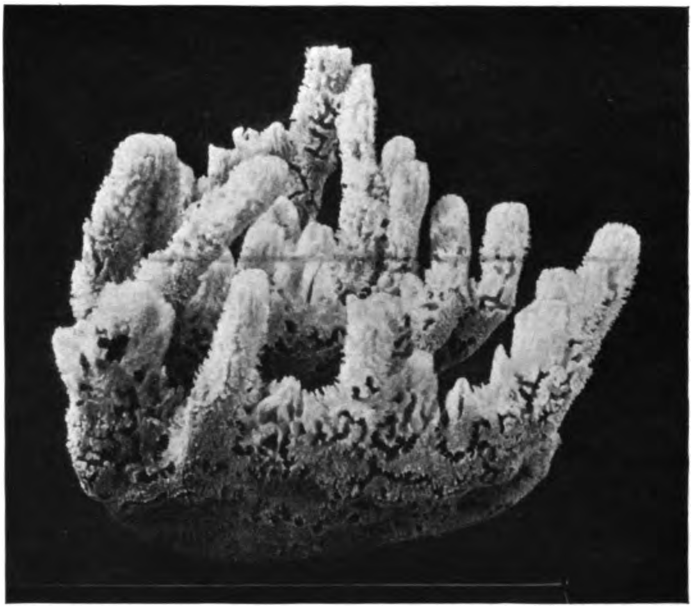


FIG. 12.—A BAHAMAN COMMERCIAL SPONGE (*Hippospongia sp.* Hyatt)
Showing colony of tube-like individuals.

therefore its peculiar features remain constant to the groups of which they are characteristic. It may be composed either of fibers or spicules, and it is secreted by the mesoderm. Its function is to furnish a rigid supporting framework for the body and to act as a protection against the enemies of the sponge.

The fibrous sponges include among others those known to commerce. The skeleton is, in most cases, made up of interlacing and anastomosing fibers of a horny substance called *spongin*,

closely akin to silk in chemical composition. It is secreted by the mesoderm and is arranged so as to be a supporting basis to the layers of cellular tissue composing the soft parts of the animal. The fibers are of two kinds,—first, a set of long stout ***principal fibers*** (see Fig. 11), from $\frac{1}{2}$ to $\frac{1}{1}$ mm. in diameter, radiating from the base of the sponge to its surface, and secondly, a complicated network of fine *connective fibers* interlacing between the principal fibers and supported by them. The connective fibers are extremely delicate, having a diameter of only .01 to .02 mm. and with meshes scarcely as large as their diameter. Grains of sand are often found imbedded in the principal fibers, in some cases forming a considerable part of the skeleton, in others the entire substance. The spongin fiber is made up of a soft central core

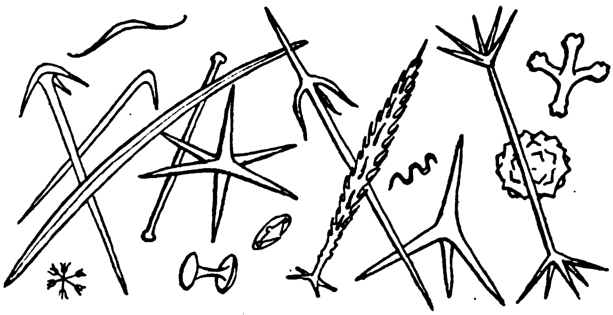


FIG. 13—SOME TYPICAL FORMS OF SPONGE SPICULES

or *medullary axis*, surrounded with successive layers of the spongin substance. The classification of the horny sponges is based upon the minute characters of the network. A few sponges of small size have no skeleton at all, being supported by whatever rigidity their tissues may possess, but with these exceptions all except the horny sponges have skeletons made up of ***spicules*** instead of fibers. These are small needle-like bodies composed of either carbonate of lime or silicon. The latter is found combined with water in such proportions as to form a substance chemically resembling opal, and of transparent glassy appearance. Hence spicular sponges may be classified as calcareous or silicious according to the nature of their skeletons. Spicules may have one or two axes, or their axes may radiate in 3, 4, 5, 6, or even 8 different directions, and are found in a great variety of forms,

some of which are shown in Fig. 13. Those having one or two axes may be straight, curved, or bent at various angles. They may be pointed, rounded or knobbed at one or both ends. They may be smooth or spined. Spicules having a greater number of axes may also have their arms pointed, rounded or knobbed, or each arm may be branched, either once or twice, or to such a degree as to present a great variety of star-like figures. Spicules occasionally assume extremely odd shapes. Some look like tiny cuff-buttons, others like anchors, horseshoes and hooks of peculiar design, while still others are coiled like springs. As regards size they may be divided into two classes:

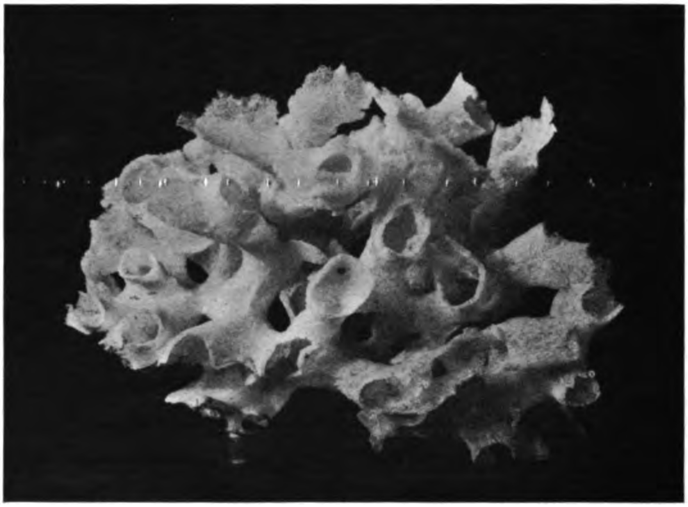


FIG. 14.—A DICTYONID SPONGE (*Farrea occa* Carter)
With rigid lattice-like skeleton.

megascleres, or large spicules, and *microscleres*, or small spicules. The megascleres form the main supporting structure of the skeleton and are bound together in long fiber-like bundles which are either parallel, or cross each other so as to form triangular or square meshes. They are sometimes entangled and interlaced in all directions like felt, clinging to each other with their hooks and projections. In the Dictyonid sponges (Fig. 14) the megascleres are of three axes at right angles to each other and are arranged with points overlapping. During the life of the sponge these

grow together and finally form a perfectly rigid network. The microscleres on the other hand are not supporting in function. In fact in most cases their use is unknown. They are found embedded in the fleshy parts of the sponge and are so minute as to be distinctly visible only under a high power of the microscope. They are extremely valuable in determining species.

REPRODUCTION AND DEVELOPMENT.

Sponges may reproduce either by budding (*asexual reproduction*), or by means of eggs (*sexual reproduction*). Reproduction by budding is brought about by an outgrowth of cells from the side of the sponge involving all three layers. This finally develops

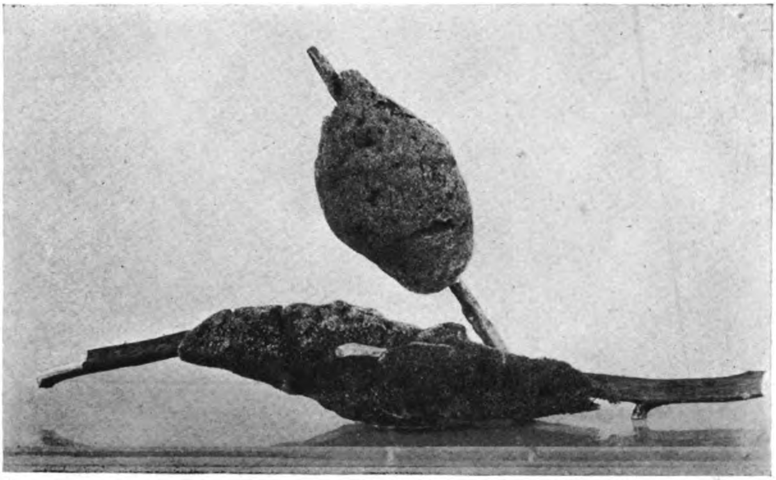


FIG. 15.—FRESH WATER SPONGES (*Spongilla* sp.)

into a miniature of the parent sponge, as far as structure is concerned, becomes narrowed at the base until it is only attached by a stem, and finally drops off. It then becomes fixed to the sea-bottom and grows to maturity. Sexual reproduction on the other hand is only effected by the union of sexual elements within the tissues of the parent sponge. The male and female reproductive cells originate in the mesoderm of the same individual and unite to form the fertilized unicellular egg. The larva is developed from the one-celled stage, by a process of cell division or cleavage. It passes through 2-, 4-, and 8-celled

stages by vertical divisions, at the end of which time it appears as a circular disc divided into eight equal segments. These again divide into a 32-celled stage by means of a horizontal or *equatorial* cleavage, and then, by repeated divisions of the eight upper cells, a hollow sphere is formed composed of eight large granular cells and many small cells, each of the latter bearing a long flagellum or whip-like filament. The eight large cells divide more slowly, always remaining comparatively large, and are not provided with flagella.

At this so-called *blastula* stage the larva issues from the

FIG. 16.—A GROUP OF NEPTUNE'S GOBLET SPONGES (*Poterion neptunei* Harting.)
The tallest specimen is 33 inches high.

endoderm of the parent and finally passes out through the osculum of the sponge. It swims rapidly about with its flagellate portion in front, and after a time the large granular cells grow around and enclose the flagellate cells. Soon a sup-chaped body is formed, known as the *gastrula*, which is covered with non-flagellate cells, and lined with a multitude of flagellate cells. The opening of the cup, or *blastopore*, now narrows and almost immediately the larva settles down and becomes fixed by the rim of the blastopore to a rock or some other object. The development is now very

rapid. The blastopore closes; the flagellate cells develop collars and become choanocytes; the osculum or excretory opening perforates the free end; the side walls are pierced with pores; traces of the skeletal spicules begin to show in scattered mesodermal cells as tiny needles of glass or carbonate of lime; and the body assumes a somewhat cylindrical shape. From now on the animal possesses all the elements of a true sponge, and growth proceeds according to its nature and environment.

PHYSIOLOGY.

This subject, in its application to sponges, is very imperfectly known.

The following facts, however, can be definitely stated:

The adult sponge is attached and is incapable of locomotion. Its only outward movements seem to be a slow dilatation and contraction of the pores and the osculum.

The choanocytes, however, are very active. The flagella are in constant vibration, and the collars are continually expanding and contracting. These cells are the chief organs of nutrition and respiration. The motion of the flagellum creates a whirlpool, by means of which the sea-water and the organisms it contains are sucked down within the collar. The cell then seizes upon, and absorbs the digestible organisms, while the constantly renewed sea-water, being brought into closer relation with the absorbing tissues, causes the necessary oxygenation to take place.

Excretory products are, without doubt, cast out by these cells and together with the indigestible organisms are borne out through the osculum by the main current of sea-water.

It is also said that during the winter many choanocytes disappear, to be restored in the spring-time. Thus a kind of hibernation seems to occur.

The growth of sponges is slow, five or six years being necessary to bring them to their full size. This, however, is very variable.

There is no muscular or nervous system. Instead, there is what has been called a "vague general sensibility" of the whole

sponge. This shows itself particularly in the movements of the osculum and pores.

Sponges may grow together if placed in contact, or, on the other hand, fragments cut from a sponge can be made to live and grow separately. This peculiarity is utilized in connection with the artificial propagation of the commercial sponges. Sponges do not, however, regenerate parts which have been cut off, although the original sponge may go on growing as if nothing had happened.

POSITION OF SPONGES IN THE ANIMAL KINGDOM.

The relation of sponges to other animal forms has always been very uncertain. The choanocytes of the endoderm seem to connect them with a group of colonial Protozoa known as *Choanoflagellates.* These are the only other animal forms which have "collared cells." In fact certain colonies of Choanoflagellates (*Proterospongia*) very much resemble primitive sponges. On the other hand sponges have often been grouped with the Cœlenterates, on account of the resemblance of the planula and gastrula larval stages to those of the Jellyfishes; because of the fixed condition of the adult, the simple structure and the sac-like internal cavity; as well as the supposed resemblance of the osculum to the Cœlenterate mouth. The latter resemblance is only apparent, however, as the osculum does not function as a mouth, nor does it have the same embryological history. Sponges, moreover, differ widely from Cœlenterates in their lack of tentacles and "sting-cells," or *nematocysts*, and are peculiar in having pores, "collared cells," and spicular skeletons. These differences are so important that it has been necessary to recognize the sponges as a separate subkingdom, most probably having a common ancestry in some group immediately derived from the Protozoa.

CLASSIFICATION.

On account of the difficulties besetting sponge classification many very widely differing schemes have been proposed. The earliest were based largely on external forms and the chemical

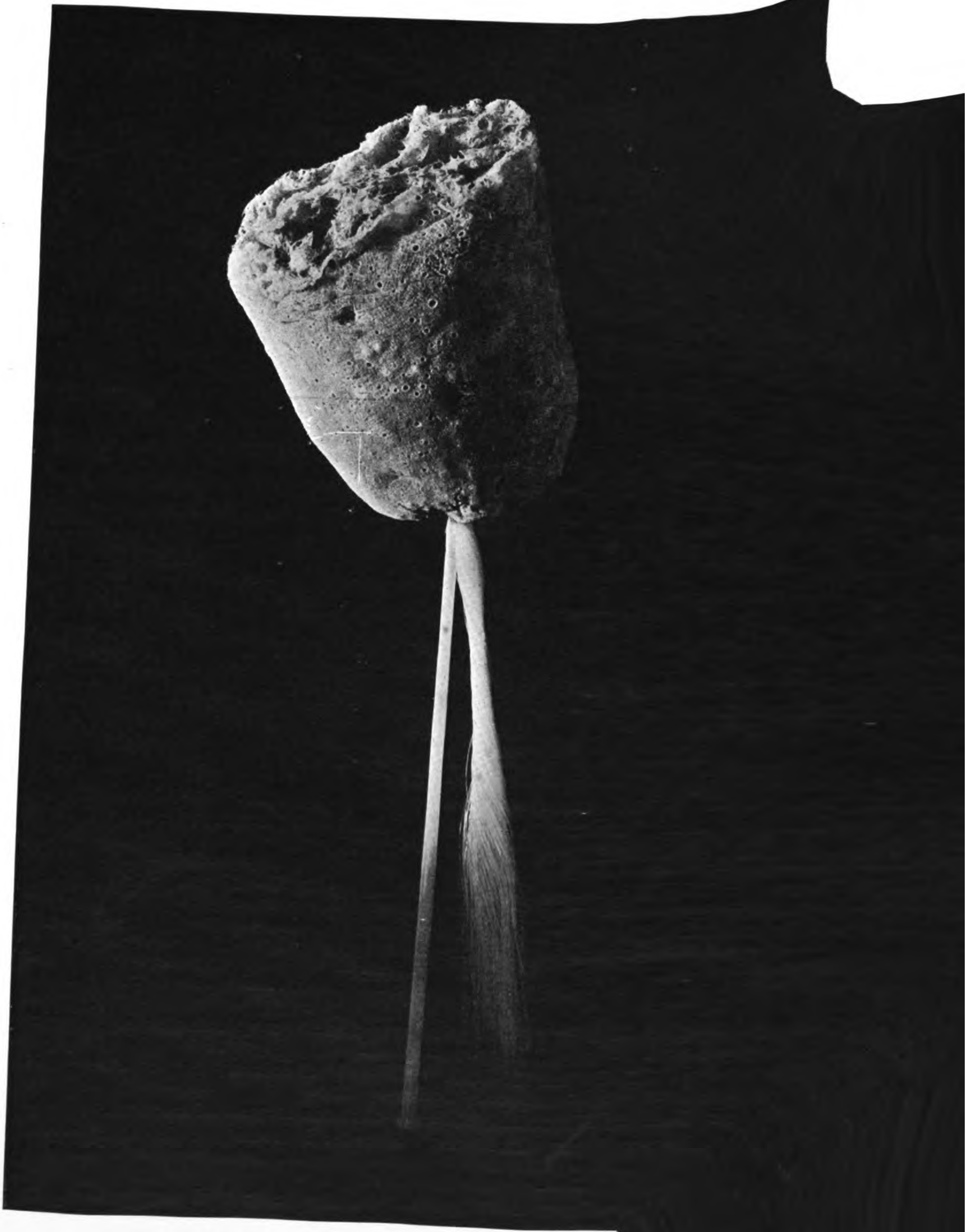


FIG. 17.—A GLASS ROPE SPONGE (*Hyalonema sieboldii* Gray)

The twisted rope-like bundle of opal spicules projecting from the base of the sponge, forms a supporting structure in life, the lower end being embedded in the mud.

composition of the sponge skeleton. The latter basis is still used for the division into classes, but the former has been for the most part abandoned on account of the plastic nature of the framework of sponges and the consequent variability of their growth-habits. Such internal features as the form and arrangement of the spicules, the extent of the choanocytic layers, and the general plan of the canal system, seem to be more constant characters, and are utilized in all recent classifications. There is, however, much variability among internal characters also, and there are yet many perplexing problems to the spongologist, especially on account of the great number of intermediate forms and unexpected relationships. In fact a genealogical diagram of the sponges would not so much resemble a branching tree, as a network with connecting fibers anastomosing in all directions, and most probably approximating in its appearance the bewildering skeletal labyrinth of the fibrous sponge itself. The following synoptic table, modified from Delage and Herouard, seems to be for the most part in harmony with recent researches, and as likely as any to have some degree of permanence, as it is largely based on internal structure, *i. e.* the skeleton and canal systems:

PORIFERA.

No nematocysts, no mouth, but with inhalent pores; a cloacal atrial cavity with a simple or multiple osculum; a mesoderm.

A. Class CALCAREA. Spicules calcareous; choanocytes large.
- a. Order **HOMOCŒLIDA**. Atrial cavity lined with choanocytes. (*Leucosolenia,* Ascetta, Ascyssa, Homoderma.*)
- b. Order **HETEROCŒLIDA.** Atrial cavity lined with pinacocytes (pavement cells), the choanocytes being withdrawn into radial diverticula or ciliated chambers. (*Sycon, Grantia,* Ute, Barroisia, Leucilla, Leucandra, Eilhardia, Eudea, Petrostoma.*)

B. Class NON-CALCAREA. Skeleton of silicious spicules, or of spongin fibers or no skeleton. Choanocytes small.
1. Subclass TRIAXONIÆ. Ciliated chambers large, elongated; skeleton of triaxial spicules or none.
   - a. Order **HEXACTINELLIDA.** Skeleton formed of spicules.
     - (1) Suborder LISSACINA. Spicules independent during growth. (*Euplectella,* Askonema, Rosella, Lophocalyx, Hyalonema,* Semperella.**)
     - (2) Suborder DICTYONINA. Spicules united during growth to form a rigid trellis-work. (*Farrea,* Aphrocallistes,* Hexactinella,* Dactylocalyx, Ventriculites, Cœloptychium.*)

* Represented in Museum Collection.

b. Order **HEXACERATIDA.** Skeleton formed of fibers, or no skeleton. (*Darwinella, Aplysilla, Halisarca.*)

2. Subclass DEMOSPONGIÆ. Ciliated chambers small; skeleton formed of spicules of one or four axes; or no skeleton.

a. Order **TETRACTINELLIDA.** Skeleton formed of tetraxial megascleres, rarely reduced to microscleres, or no skeleton at all.

(1) Suborder CHORISTINA. Skeleton flexible, without interlocking desmas.

(i) Family **Sigmatophoridæ.** Megascleres present. Microscleres in the form of sigmaspires, or none. (*Tetilla, Cinachyra.*)

(ii) Family **Astrophoridæ.** Megascleres present. Microscleres in the form of asters. (*Thenea, Stelletta, Disyringa, Geodia, Pachymatisma.*)

(iii) Family **Microsclerophoridæ.** No microscleres. (*Plakina, Oscarella, Chondrosa.*)

(2) Suborder LITHISTINA. Skeleton rigid, formed of interlocking desmas.

(i) Family **Triænidæ.** Ectosome containing triænes. (*Theonella, Desmanthus, Siphonia, Corallistes, Pleroma.*)

(ii) Family **Rhabdosidæ.** Ectosome containing microstrongyles, free or in desmas. (*Neopelta.*)

(iii) Family **Anoplidæ.** Ectosome without spicules. (*Azoriea, Vetulina.*)

b Order **MONAXONIDA.** Skeleton formed of megascleres of only one axis.

(1) Suborder HADROMERINA. Ordinarily with a cortex; megascleres in radial bundles; microscleres in asters or absent, never in the form of spires or sigmas.

(i) Family **Aciculidæ.** Diactinous megascleres. (*Tethya, Hemiasterella, Stylocordyla.*)

(ii) Family **Clavulidæ.** Monactinous megascleres. (*Spirastrella, Suberites,* Polymastia, Cliona.*)

(2) Suborder HALICHONDRINA. Ordinarily no cortex; megascleres entirely oxeas arranged in a network. (*Spongilla*, Chalina*, Reniera, Halichondria, Tedania, Esperella, Cladorhiza, Myxilla, Clathria, Axinella.**)

c. Order **MONOCERATIDA.** Skeleton formed of spongin fibers with or without microscleres. (*Euspongia,* Hippospongia,* Aplysina,* Druinella, Stelospongia,* Hircinia,* Spongelia,* Phoriospongia.**)

* Represented in Museum Collection.

TYPICAL SPONGES IN THE MUSEUM.

A. CALCAREOUS SPONGES (CLASS CALCAREA)

The most conspicuous characteristic of this class is the calcareous or carbonate of lime skeleton. The class is divided into two groups, the first containing those sponges whose hollow interior (paragastric cavity) is entirely lined with "collared cells" (order Homocœlida), the second comprising those in which the "collared cells" are confined to thimble-like prolongations of the paragastric cavity (order Heterocœlida).

An example of the **Homocœlida** is the Ascon sponge *Leucosolenia primordialis* Häckel. The genus to which this species belongs is found in all seas to a depth of 6000 feet. Its manner of growth varies from solitary, erect, cylindrical sponges to encrusting colonies of serpent-like tubes ramifying in a complicated network. Sometimes the whole colony assumes an erect vase-like form with walls made up of entwining tube-like individuals. The sponge on exhibition is of the encrusting type, growing in this instance on a colony of barnacles.

The Sycon sponge, *Grantia ciliata* Fleming, represents in the exhibition the order **Heterocœlida**. This is a common species found all along the New England sea-coast. It is a small tubular sac with the osculum surrounded by a circle of finger-like spicules, as shown in the illustration on page 224. It grows from an inch to an inch and a half in length, in small cluster-like colonies attached to sea-weed, submerged timbers, shells, etc. The specimens in the glass jar are growing on a mussel shell which is also partly encrusted with small star-shaped colonies of the interesting Ascidian, *Botryllus*.

B. THE NON-CALCAREOUS SPONGES (CLASS NON-CALCAREA).

The sponges of this class have no traces of carbonate of lime in their skeletons. Instead some contain silicious spicules

FIG. 18.—A RARE "GLASS" SPONGE (*Hyalascus similis* Ijima)
This graceful specimen illustrates the vase-like growth of many sponge colonies
(Height, 15 inches.)

(the so-called "glass" sponges), or their skeletons may be partly or entirely made up of a network of spongin fibers. A few sponges have no skeletons at all.

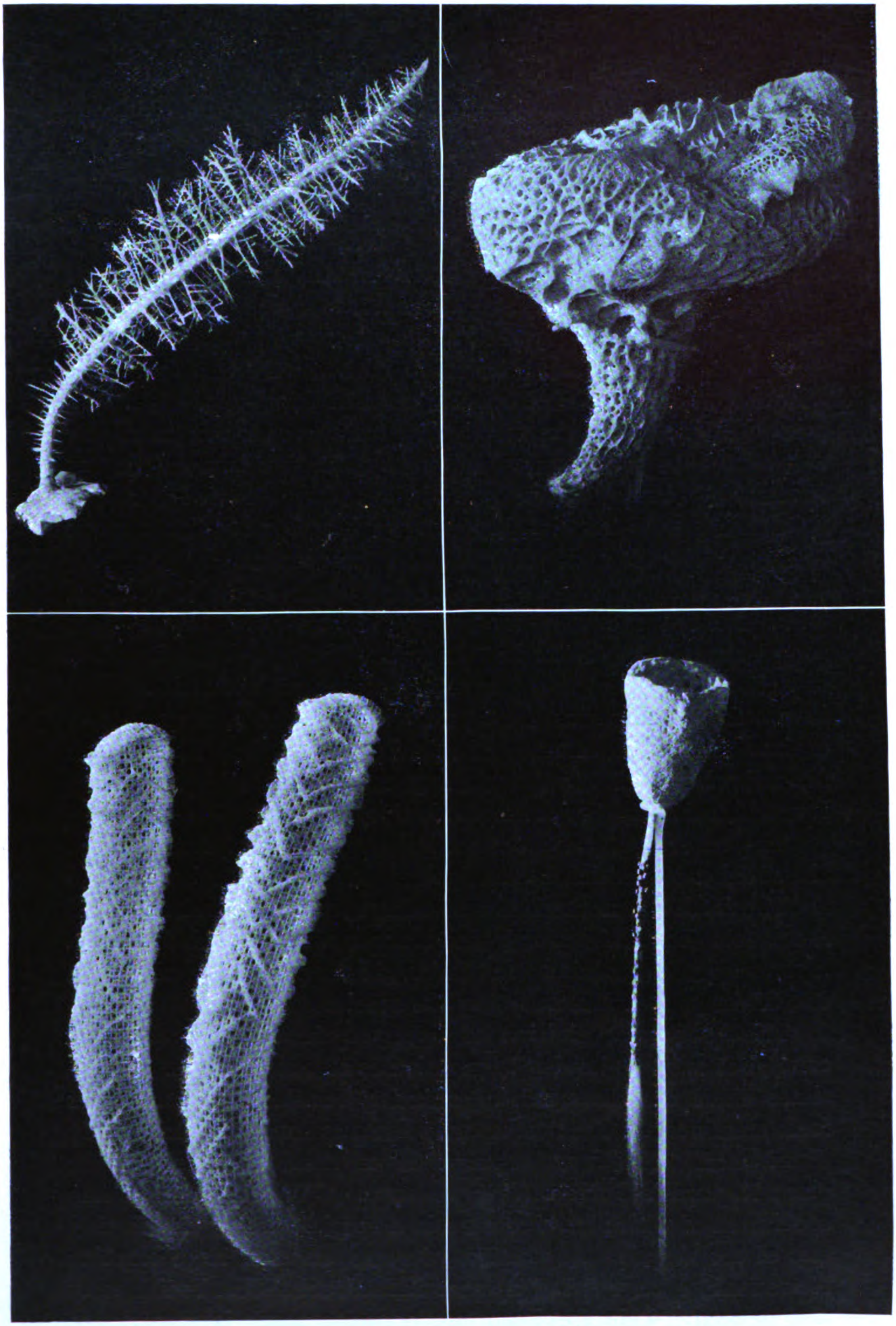
Those sponges which have six-rayed spicules belong to the order **Hexactinellida,** a group marked by forms of unusual beauty and grace, of which a fine collection is shown in this alcove. In some of these (suborder Lissacina), the spicules are independent during growth and are felted together by means of their hooks and spines; in others (suborder Dictyonina), the overlapping ends of the spicules have grown together to form a rigid lattice-like framework.

Suborder Lissacina.—The several species of *Euplectella* (Venus's Flower-basket) are especially noticeable for delicate beauty, while *Walteria* is remarkable for its odd tree-like form. *Acanthascus*, *Rhabdocalyptus* and *Crateromorpha* are also represented by fine specimens, (see opposite page) and give a good idea of the variety of forms which these sponges may assume, while the remarkable vase-like *Hyalascus similis* Ijima (Fig. 18, p. 239) is not only the type of its species, but is the only specimen known to have been found.

The so-called "glass-rope" sponges (*Hyalonema*) are remarkable for the twisted, cylindrical bundle of elongated spicules projecting from the lower end. In life this stalk-like support is anchored in the mud at the sea-bottom by means of barbs and hooks at the lower end of the spicules. An interesting peculiarity of this sponge is its association with tiny Zoöphytes (*Palythoa*) which are always found growing upon its stem (see Fig. 22). This is an illustration of the phenomenon of *symbiosis*, indicating an association of two animal forms for their mutual advantage.

Suborder Dictyonina.—The two specimens of *Farrea occa* Carter (see Fig. 14, p. 230) and *Aphrocallistes* show particularly well the lattice-like framework peculiar to this group, and also the characteristic manner of growth of these sponges.

The glass sponges are all universally distributed in the deep waters of tropical seas. Most of the specimens exhibited in this Museum were collected in the Sagami Sea, an arm of the Sea of Japan. This is a particularly favorable locality, as the sea-bottom falls away rapidly to a great depth close to the shore,



FIGS. 19-22.—SOME TYPICAL "GLASS" SPONGES

FIG. 19.—A tree-like species (*Walteria leuckhardti* Ijima).

FIG. 20.—The Cactus Sponge *Acanthascus cactus* Schulze).

FIG. 21.—Venus's Flower-basket (*Euplectella speciosissima* Owen).

FIG. 22.—A Glass-rope" Sponge (*Hyalonema owstoni* Ijima) with *Palythoa* growing on stem.

thus giving an opportunity for deep sea forms to stray up into comparatively shallow water.

The native method of collecting these sponges is interesting. An apparatus called a "dabo line" is used. This is a long line about an eighth of an inch in thickness, to which smaller branch lines or "snoods" are attached at short intervals. Each "snood" ends in a brass or iron wire hook with a barbed point. The "dabo lines" are coiled in baskets placed in the bottom of a boat manned by five or six men. The hooks are stuck in a row around the edge of the basket, and as the line is uncoiled, are successively unfastened by one of the men. The line is set by tying one end to the end of a long rope weighted with a stone sinker. The latter is then lowered perpendicularly, carrying the "dabo-line" with it, until the required depth is reached, when the upper end is moored to a buoy. The boat is then rowed away until the entire "dabo line" is paid out, when it is attached to another strong rope also weighted, which is lowered in the same manner as the first, and moored to a buoy. After a time the line is taken up, beginning at the first buoy, when sea-animals of all kinds including many "glass" sponges are found either hooked or entangled in the "snoods."

The order **Tetractinellida** comprises living and fossil forms, the skeletons of which are composed of four-rayed spicules.

The fossil Tetractinellids and other sponges are well shown in the Geological Hall, fourth floor, north wing of this building. *Hyalotrogos*, *Cnemidiastrum*, *Leidorella* and *Callopegma* are a few of the genera illustrated by the specimens.

The next great division of sponges, the order **Monaxonida,** comprises sponges having large spicules of but one axis. Sometimes these are arranged in radiating bundles and sometimes form a network. The species are quite numerous and universally distributed. The most remarkable of these sponges are the giant Neptune's Goblets (*Poterion neptunei* Harting), three fine specimens of which may be seen in a special case at the farther end of the alcove. At the left of these, another large cup-like Monaxonid sponge fished up near Santa Lucia, West Indies, may also be seen. This specimen (see opposite page) is remarkable for its size and beauty, for the peculiar irregular knob-like

FIG. 23.—A REMARKABLE VASE-LIKE MONAXONID SPONGE
From Santa Lucia, W. I. (Height 31½ inches).

projections on its surface, and for its very fragile texture. Other noteworthy specimens belonging to this order are as follows:

Spongilla sp. (illustrated on page 231.)—This is an example of the fresh-water sponges which form the only exception to the rule that sponges are marine animals. In color it is usually yellowish, often tinged with green or brown. It is universally distributed in streams and ponds.

Pachychalina.—This genus consists of usually elongate, finger-like and branching sponges in which the spicules are buried in a horny coating of spongin. The numerous excretory openings, or oscula, are conspicuously scattered over the external surface.

FIG. 24—THE STOLON-BEARING SPONGE (*Siphonochalina stolonifera* Whitfield)
A peculiar adaptation of the branching habit.

Siphonochalina.—This is closely related to the preceding genus, but consists of a group of tube-like individuals varying in form, and with spongin of somewhat paper-like texture. This genus is represented by several species, of which *Siphonochalina stolonifera* Whitfield is the most remarkable. This beautiful sponge is illustrated in the above cut of the type specimen. It consists of a number of tubes with crown-like summits, growing

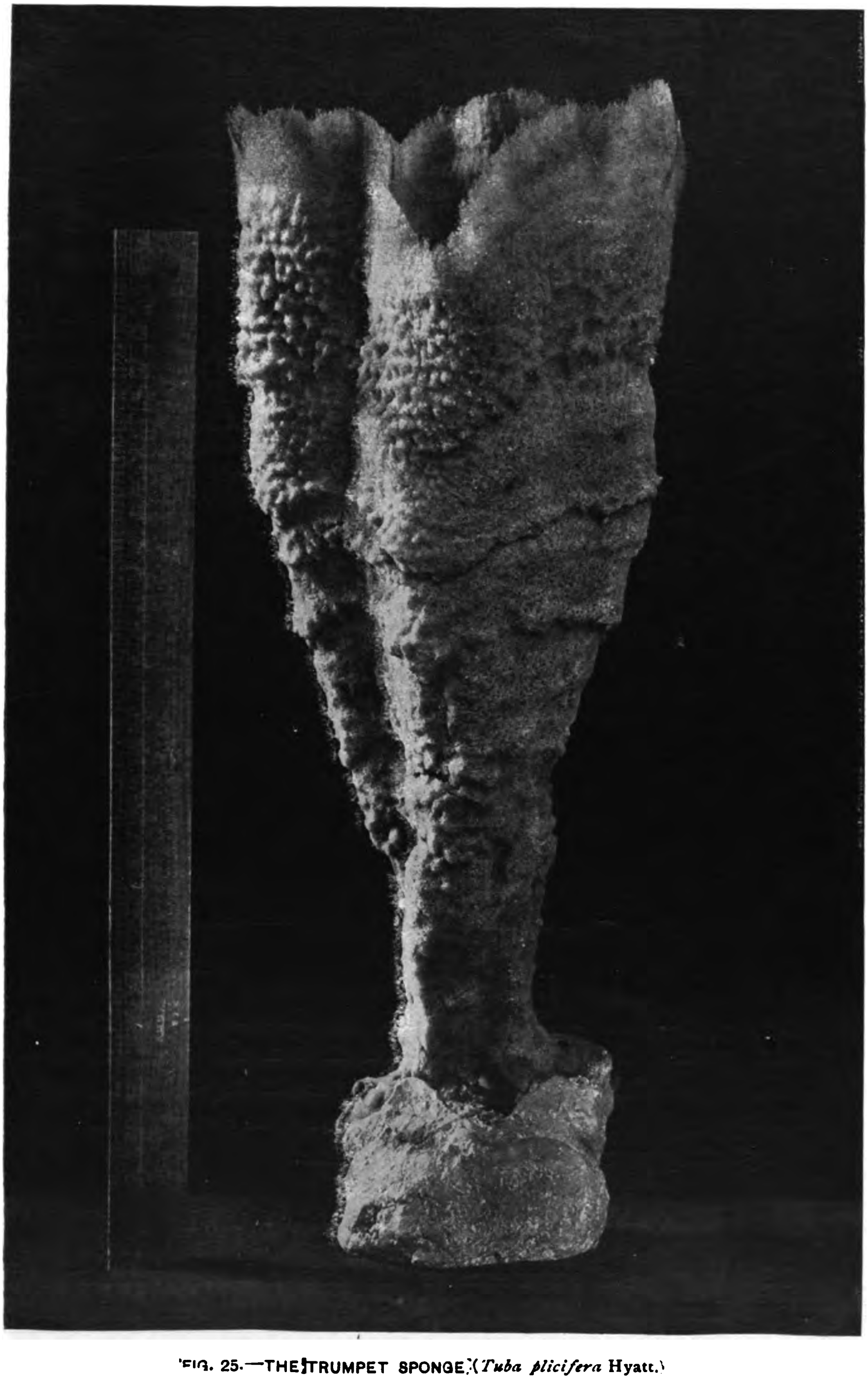


FIG. 25.—THE TRUMPET SPONGE. (*Tuba plicifera* Hyatt.)

from a common base, and connected with each other by root-like stolons, which form the attachments to the rocks on which they grow. The texture of the skeleton is very fine and smooth.

Tuba.—The genus *Tuba* is represented by two species *T. bullata* and *T. plicifera.* These are more or less trumpet-shaped as the name implies. The specimen illustrated on page 245 is especially fine.

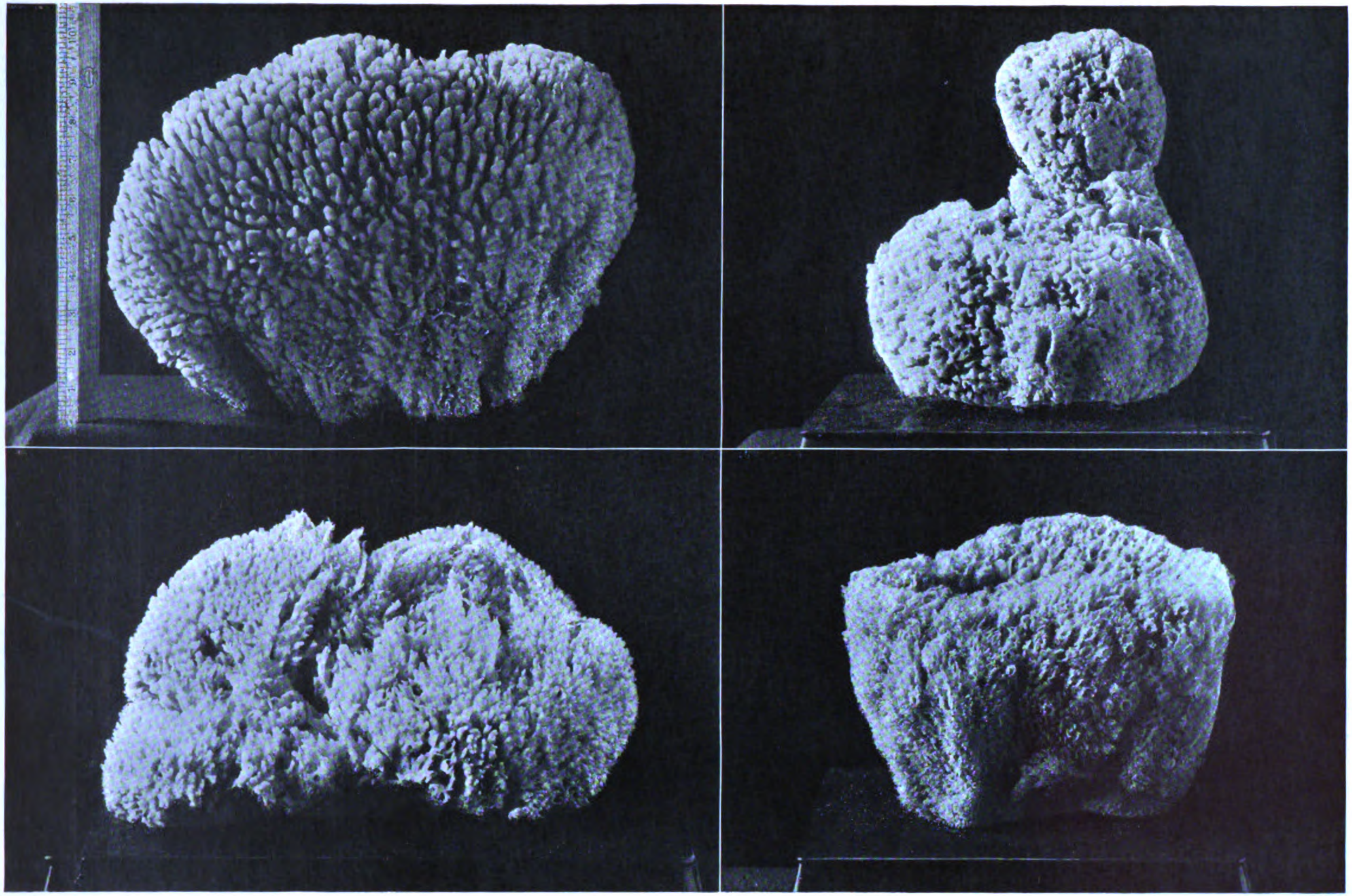
The Horny Sponges (order **Monoceratida**) includes the sponges whose skeletons are entirely made of the spongin substance. The most typical and most important of these are the commercial

FIG. 26.—THE ZIMOCCA SPONGE (*Euspongia zimocca* Schulze)

sponges. They are divided into the genera *Euspongia* and *Hippospongia.* In addition to these the fine finger-like sponges of the genus *Chalinopsilla*, the black branching skeleton of *Hircinia atra* Whitfield (type) and the graceful cup-like specimens of *Stelospongia* (see illustration on page 227) are worthy of note, although they possess no commercial value.

THE COMMERCIAL SPONGES.

The sponge of commerce is the elastic horny skeleton of spongin from which all the living tissues of the animal have been removed. The principal sources of supply are:



FIGS. 27-30—FOUR GRADES OF AMERICAN COMMERCIAL SPONGES

FIG. 27.—The "Velvet" Sponge (*Hippospongia meandriformis* D. & M.).

FIG. 28.—The Florida Yellow Sponge (*Euspongia corlosia* D. & M.).

FIG. 29.—The "Sheep's Wool" Sponge (*Hippospongia gossypina* var. *hirsuta* Hyatt).

FIG. 30.—The Grass Sponge (*Euspongia graminea* Hyatt).

(1) The Mediterranean coast, including the gulfs, bays and islands from Italy to the Levant, and the whole African shore.
(2) The Bahamas, Florida, and the north coast of Cuba.
(3) Australia and a few of the Pacific Islands.

There are three grades of European sponges, *i. e.*, the Turkey or Levant Sponge, the Horse Sponge, and the Zimocca Sponge.

FIG. 31.—THE SYRIAN SILK SPONGE (*Euspongia officinalis* var. *mediterranea* Schum.)
The finest quality of Mediterranean sponge.

The Turkey or Levant Sponge (*Euspongia officinalis* var. *mediterranea* Schum.) is shown in the illustration. It is the finest grade of sponge known. Its texture is very soft, fine and silky. On account of the latter quality it is often called the Syrian Silk Sponge. This same species grows in Florida but is of very poor quality, probably on account of the climate and other differences in its surroundings.

The next grade of Mediterranean Sponge is the Horse Sponge (*Hippospongia equina* O. S.). Its quality is very fine and is paralleled on the Florida coast and in the Bahamas by the Velvet

and Sheep's-wool Sponges (*Hippospongia meandriformis* D. & M. and *H. gossypina* Hyatt). These are the best of American bath-sponges. (Figs. 27 and 29)

The third grade, the Zimocca Sponge (*Euspongia zimocca* F. E. Schulze), is not as soft as the others, and corresponds to the Florida Yellow Sponge or "Hardhead." (Figs. 26 and 28).

The Grass Sponge (*Euspongia graminea* Hyatt. Fig. 30) is the poorest grade of American sponge and is of little commercial value.

Sponges grow attached to rocks and other objects at the sea-bottom. They are obtained in shallow water by means of long iron hooks, which, however, often damage the sponges by tearing them. The most perfect specimens as well as the largest are obtained at greater depths by divers. The Dalmatian fishermen are very skilful at this. The diver is stripped and has a small rope attached to his waist weighted with a slab of stone. He seizes the stone in his hands and dives to the bottom. A skilful diver can remain under water for two to three minutes, during which time he quickly gathers whatever sponges he can find and places them in a net attached to his neck. He is then quickly drawn to the surface. Diving by this method is confined to the summer season, as the winters are too cold for such work. The Greek divers use a water-glass to locate their sponges. This is a metal cylinder somewhat longer than a band-box, open at the top and closed at the bottom by a plate of glass. By holding the glass-covered end below water, a person looking through it can easily see the bottom at a depth of 180 feet. The divers work in regulation diving-suits supplied with air from above. Under these circumstances they can remain below for a length of time varying from an hour to a few minutes, depending on the depth at which they are working. The best sponges are obtained in this way, as they are more perfect and of larger size in deep water, and can be removed from the rocks with greater care.

Dredging is also practised off the coast of Asia Minor.

Sponges are prepared for the market by first exposing them to the air until the animal matter begins to decay. They are then washed, either by beating, by treading them with the feet,

or by exposing them to the action of the waves in so-called "crawls" or pens, until the skeletons are entirely freed of animal matter. They are then hung up to dry, baled, and sent to the market. Sometimes sponges are more quickly prepared by being bleached with chemicals. This gives them a very light color but impairs their quality. Sometimes when sold by weight they are adulterated with sand.

Sponge-fishing has been carried on so unwisely and with so little thought for the future, that the supply has been steadily declining in recent years, and lately the governments of the various countries concerned, foreseeing the almost certain destruction of the sponge industry, have attempted to regulate it in various ways and also to increase the supply by artificial propagation.

In Florida and Italy, more or less successful progress has been made, especially in the matter of sponge propagation. This is done in the winter season by choosing uninjured specimens and cutting them up into fine pieces about an inch square, on a board kept moist with sea-water. These "cuttings" are then placed on the ends of sharpened stakes held upright in a weighted wooden framework. This is sunk in a sheltered bay with a rocky bottom, free from mud, and protected from cold currents. If properly treated in this manner sponges will treble their size in a year and will be ready for the market in from five to six years.

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